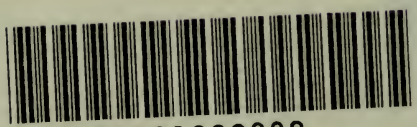
MALVERN

ITS CLAIMS AS A HEALTH RESORT



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MALVERN FROM PICKERSLEIGH

MALVERN;

ITS CLAIMS AS A HEALTH RESORT;

WITH

NOTES ON CLIMATE,

IN ITS RELATIONS TO HEALTH AND DISEASE.

ALSO, AN

EXPOSITION OF THE PHYSIOLOGICAL AND THERAPEUTIC INFLUENCE OF COMPRESSED AIR.

BY

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PREFACE.

THIS volume is issued as a contribution to medical topography. It is the result of years of observation and research. The choice of climate to invalids is a subject often equally perplexing to the medical man and to the patient. As elsewhere enforced, invalids require not merely change of air, but other hygienic requisites—as, for example, comfortable dwellings, good food, and good drainage. The natural pure air of many of our most celebrated continental watering-places is rendered noxious by bad drainage and other sources of malaria. The vital statistics of several of these places exhibit an extent of mortality in the resident population which is not calculated to encourage visits from invalids. Many invalids who travel abroad do so at the expense of the little vital power which disease has left, and which, under more genial influences, might have been beneficially nursed.

Doubtless there are numerous cases which receive benefit by a change of climate—nay, even life itself. This fact I desire strongly to recognise. It is against the rage or fashion for con-

tinental resort that I desire to raise my voice. Special cases, of course, require special means. England, however, can claim to be the healthiest country in Europe;—and I think that the present volume will show that Malvern is the healthiest climate in England. The latter position, however, does not at all controvert the fact that other watering-places may be more adapted than Malvern for certain classes of invalids. This is a point to be determined by the nature of the case; and here the physician requires statistical and topographical evidence to guide him in his advice. Such data I have endeavoured to give in the following pages.

The therapeutic influence of compressed air receives somewhat extended notice in this volume.

It has received that consideration because it is a subject intimately connected with the therapeutic influence of climate. The compressed air-bath is an attempt to secure the influence of modifications of climate *at home*, such as density of the atmosphere, and its hygrometic and other conditions. The philosopher Boyle, at a very early period, suggested some speculations on this subject; and Dr Henshaw, an English physician in 1664, recommended an ingenious mechanical adaptation on the general principle of the modern air-bath. Dr Henshaw entertained the view that the humours of the body are altered and changed by the qualities and conditions of the air, and this in particular in change of climate. Reasoning on the difficulty of a large class of invalids visiting different portions of the globe, and also taking into consideration the fact that physicians seldom permit their

patients to go abroad, except as a *dernier* resource, and when other remedies have been applied in vain, thus rendering the change almost useless in its results from want of earlier application, Dr Henshaw adds—"Now I will show the manner of a contrivance by which *any person may receive the benefit of a removal to another climate, at any season of the year, without removing from his own house or neglecting any employment whatever.*" The ingenious Doctor then proceeds to describe a domestic *domicilium* or air-chamber, by means of which "the room may be charged or discharged of it (air), and consequently the air it contains may be of whatever tenuity or density is required." After various mechanical details and medical suggestions, Dr Henshaw adds—"Whatever benefit a change of air produces in diseases may be reasonably expected from the use of this domicilium. By means of it the patient may provide himself such air as was not otherwise to be found but on the Peak of Teneriffe, or some other very high mountain; nay, he may rarefy the air to a far higher degree, and make it such as he could nowhere find upon the face of the habitable world. It may also be used for preventing the inconvenience that is often experienced from the sudden change of air by a person travelling into foreign countries, by reducing the tone of the air of any climate to that of his own country."

More recently, and based on modern scientific observations, a distinguished physiologist, Dr J. Burdon-Sanderson, remarks, that he regards "the compressed air-bath chamber as an important remedial agent. It belongs to a class of remedies which we

may hope will become more and more numerous—remedies which act not by introducing into the living organism substances foreign to its constitution, the extent of action of which we are often as unable to estimate as to control, but by directly counteracting the physiological disturbance ascertained to exist, thus adjusting the disturbed equilibrium of function, not by depressing or weakening those functions which are natural, so as to bring them into harmony with those which are diseased (which is the principle on which much of our treatment is based), but rather by directly restoring and strengthening those which are impaired." *

The author cordially invites the members of the profession to examine the compressed-air chamber in Malvern, and will afford every facility in his power for experimental investigation.

* *The Practitioner*, p. 224, 1868.

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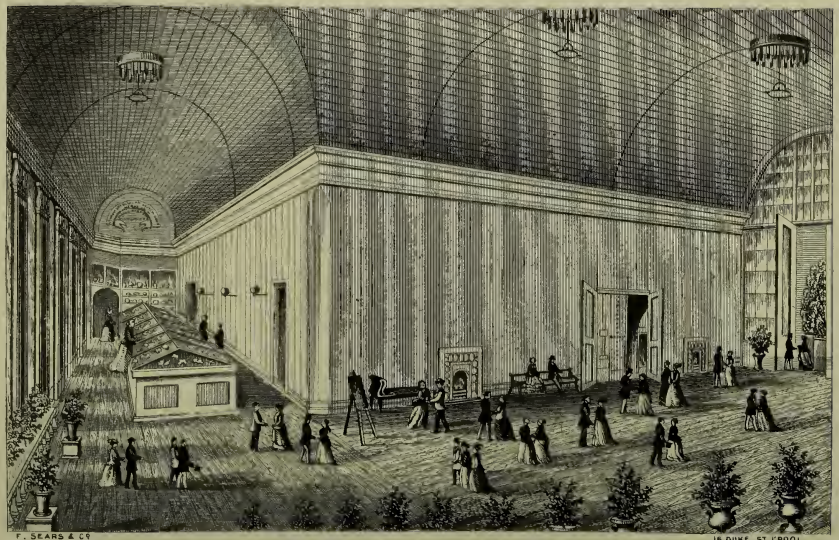


Interior of the Museum & Winter Promenade.

NOTES ON CLIMATE,

IN ITS RELATIONS TO HEALTH AND DISEASE, AND IN PARTICULAR IN REFERENCE TO THE CLIMATE OF MALVERN, AND ITS CLAIMS AS A HEALTH-RESORT.

The human body is a highly organised structure with the most elaborate vital functions. An animal electrical machine, possessing extremely sensitive properties, it is easily influenced by the constant changes of the atmosphere, in which, in an important sense at least, it lives and moves and has its being. This is eminently the case in various morbid conditions, and in particular in disordered states of the nervous structures. When the vital energy is low, the body is peculiarly susceptible of atmospheric changes. In cold seasons it loses a larger proportion of caloric by contact with the external atmosphere than it can supply from its heat-producing apparatus within, and the skin, the outer medium of relationship, with morbid nerves and deficient blood, has no adequate power of resistance. Hence, every change of wind or alteration of moisture has its corresponding effects. The atmospheric currents and hygrometic conditions also have essential bearings on the presence and transmission of ozone, and this constitutes an important element in any consideration of climate and its relations to health and disease. Such is the object of the present inquiry. On every ground it is important to ascertain the temperature of a health-resort during different portions of the year, its wind currents and the causes of their variations, geological stratification, the

moisture or dryness and purity of the atmosphere, the quality of the water, and other conditions which enable it to put forth its claims as a desirable residence in certain forms of disease.

The selection of climate is an important consideration for invalids. To the physician it is often a point of serious if not perplexing responsibility. This in most cases arises from the lack of data on which to found accurate advice. On this ground it is of great value to the medical man to have within his reach meteorological records of such districts as lay claim to merit as health-resorts — evidence founded on experience, and strictly scientific investigation. The present brochure is only an effort in this direction, the foundation of future and more extended observations. It consists of personal experience and inquiries, and also free quotations from medical and other writers, some of them residents in the district.

The experience of centuries has accorded to Malvern a high position as a resort for health-seekers. The beneficial results of a residence in the place are testified by a numerous class of invalids. To what causes, or what combination of causes, is this attributable? Let us first analyse the meteorological and other conditions of the locality, which at least have a large share in an investigation of this nature, and on these endeavour to arrive at accurate conclusions.

I.—Geographical Position and Aspect.

The geographical position of the Malvern Hills, and consequently their aspect, forms an essential element in the consideration of their climatic claims. Exposure to the influence of the sun's rays, exposure to special winds, the greater or less attraction of moisture by different influences, and the existence and transmission of ozone by atmospheric currents, these and other points have inseparable therapeutic connection with the sheltered or exposed position of the different Malverns, and even different portions of the same Malvern. The observations, for example,

made at Townshend House, Southfield, give a temperature of 2° higher than that noted in the centre of the town by the Messrs Burrow. The same difference in temperature was noted by Dr Williams at Lindfield, near to the Imperial Hotel. The wind currents of North Malvern also differ materially from those in the southern portion of the town. The causes of these various influences are obvious.

The Malvern Hills extend some eight miles in length. Their breadth varies considerably, in some portions being narrow, in others some half-mile across; in no part, however, reaching to the extent of a mile. They are somewhat irregular in their form, and are frequently indented by hollows or passes, which, in the southern portion of the range, as at the Holly Bush, are rendered picturesque by abundant tree foliage. The beauty of the hills is increased by their swelling every now and then into summits, not less than some twenty in number—several of them, as Key's End Hill, Ragged Stone Hill, Camp Hill, Malvern Wells Hills, Worcestershire Beacon, and North Hill, being of considerable height. The loftiest of the range, however, Worcestershire Beacon, does not exceed in height 1396 feet, while the Herefordshire Beacon, or Camp Hill, in its highest point reaches only 1156 feet above the sea. The height of the other hills are—Key's End, about 665; Ragged Stone Hill, 884; Midsummer Hill, 1006; Swinyard Hill, 946; Wind's Point, 830; Malvern Wells (a high point), 1224; North Hill, 1297.

The view of the Malvern range most effective in its scope on the eastern side is from the valley, on a level with the Severn, a river which is not commonly seen even from the heights, and which is about four miles distant. The view from the Old (Wold?) Hills, along the valley by Hanley, over Welland Common to Bromesberrow, gives a charming sight of the entire range, with its passes, fissures, and prominences, and the villages and houses erected on its slopes.

Due east, directly opposite to the Malvern range, extends the

long chain of hills called the Cotteswold, with its prominent outlier or promontory, Bredon Hill, the rich valley between the Malverns and Cotteswold being irrigated by the two well-known and classical rivers the Severn and Avon,—the cities and towns of Worcester, Evesham, Upton, Tewkesbury, Cheltenham, and Gloucester, catching the eye from the elevated positions. The battle-field of Evesham, and the death of Simon de Montfort; of Tewkesbury, and the melancholy fate of Edward Prince of Wales; of Worcester, and the defeat and flight of Charles the Second, present scenes of engrossing historical interest; while, in times of earlier date, there is every reason to believe that the Malvern Chase and hills formed the arena of stirring border warfare. An incursion of the Danes at Derehurst, near Tewkesbury, in the early part of the eleventh century, and flight of a monk to Malvern, led to the building of Malvern Priory, and the establishment of a flourishing colony in the midst of a dense forest and unfrequented wilderness. The occupation of the district by the Romans and Anglo-Saxons, and the patriotic resistance of the aboriginal Silures, under the leadership of Caractacus, carry us back in imagination to times no less interesting than pregnant with historical consequences.

Key's End, or Chase End Hill, which forms the southern extremity of the Malvern chain, is about nine miles from Gloucester; while the North Hill or northern termination of the range, lies about seven or seven and a half miles from Worcester.

The localities which now bear the names of Malvern are not less than six in number—Malvern Link, North Malvern, Great Malvern, Malvern Wells, Little Malvern, and West Malvern.

Malvern Link, some 200 or 250 feet below Great Malvern, on the Worcester Road, is now a populous district with numerous villas and its district church. It is situated in the parish of Leigh, and is about one mile and a half distant from the Priory Church, Great Malvern.

North Malvern constitutes a populous locality, having been

recently made an ecclesiastical district. It is mainly situated under the bend of the North Hill, chiefly at an elevation of 650 feet, but is rapidly extending its limits and population.

Great Malvern lies on the hill slope at an elevation in the centre of the town of nearly 500 feet. The mass of its houses are situated in a natural recess formed by the projecting base of the Worcestershire Beacon on the south-west and the North Hill on the north-west. There are only two rows of houses which may be called streets—the central portion of the town, with the post-office, hotels, and main shops; and Church Street, which leads to the railroad and valley below. The rest of the place consists of well-made roads studded with villas, most of them of attractive though varied architecture, and each surrounded with its garden or plantation. Many of these villas are erected at a height of some 700 feet, one of them being built on the site of the Hermitage, where resided St Werstan, the Malvern hermit and martyr.

Malvern Wells is a charming place at an elevation of 550 feet, and is mainly situated in the parish of Hanley. It has its hotels, and schools, and beautiful residences, and its hill-walks of unusual extent and beauty.

Little Malvern is not a place of health-resort, and may be considered as an extension of Malvern Wells. It is picturesquely situated at the base of the Herefordshire Beacon, and is remarkable as the site of an ancient priory, a portion of whose old ecclesiastical fabric now remains, and is used as a parish church.

West Malvern, situated in the parish of Mathon, has now grown into a place of considerable importance. Its height is 900 feet. It has a district church, and numerous private dwellings of superior build, with a hotel and abundant lodging-houses for visitors. The views from West Malvern are extremely fine and diversified, extending over much of the romantic district of Herefordshire, in which county it lies. A fosse extending along the entire line of the Malvern range divides the counties of Worcester and Herefordshire.

II.—Geological Conditions, Soil, &c.

A brief exposition of the geological conditions of the Malvern Hills is essential to a knowledge of the subjacent strata or soil of the district, and in particular to the purity of its water, and the luxuriance or growth of its vegetation.

The Malvern Hill rocks are now admitted to belong to the pre-Cambrian, Azoic, or Laurentian epoch, and include all the metamorphic rocks—in other words, those which are acknowledged to be older than the ones included in the Cambrian system. The rocks differ materially in different portions of the range, but chiefly consist of masses of metamorphosed sedimentary rocks, of interposed dykes of trap and greenstone, of syenite, diorite, and stratified gneiss.

Up to a recent period, the whole of the Malvern rocks were included under the general term of syenite, but the investigations chiefly of Dr Holl have led to more definite conclusions.

The metamorphic rocks may be briefly described as those sedimentary deposits of ancient oceans which geologically underlie the fossiliferous strata, and which, by a process of metamorphism caused by exposure to heat, pressure, or chemical and atmospheric influences, are reduced to their present condition—a condition which not unfrequently in appearance resembles the granitic or plutonic rocks. The metamorphic system of rocks consists of *gneissic* rocks and granitic schists, of *quartzose* rocks of various kinds, of *mica* schist and chloritic schists.

In an examination of the Malvern range, there will be found a considerable difference in the mineralogical character of the rocks, in some parts the gniess being micaceous, in others hornblendic. One portion is rich in diorite (a variety of greenstone composed of hornblende and feldspar, its dark colour depending on the hornblendic constituents), another is almost purely granitic, and not a few appear to be varied mineral combinations. The stratified character of the rock is in some parts very ap-

parent. The principal minerals found on the hill rocks are quartz, feldspar, mica, hornblende, chlorite, epidote, and sulphate of barytes.

On the eastern or Malvern side of the hill, the whole of the slope down to the valley, and to a considerable depth, is composed of the detritus or worn-down fragments of the superimposed rocks, and thus forms that gravelly soil which is characteristic of the district.

The immense deposit of Malvern rock in broken-up and gravelly form shows that the Malvern Hills must, at remote geologic epochs, have been of much greater height than they are at the present. By some, the estimate has been that of double their present elevation. On the western side the Silurian beds are in juxtaposition with the hill rock at a considerable elevation; but on the eastern side, the metamorphic rocks and their fragmentary deposits descend into the vale of the Severn, and come in contact with the drifts and deposits of the ancient valley stream, which has given rise to the geologic name of "Malvern Straits."

The ancient geologic height of the Malvern Hills, and the influence of atmospheric and other agencies during untold ages, in breaking down its metamorphic rocks, and casting them into the valley beneath, constitutes a condition of earth favourable to quick and effectual infiltration, in this way preventing accumulations of stagnant waters. It also forms a rocky stratum which favours the retention of warmth from the rays of a genial sun. The gravel pits on the Malvern Wells road commence at an elevation of some 600 feet above the principal villas of residents and visitors, and extend some distance into the valley, in one direction as far as Blackmoor Park, so that Malvern is literally built on the side of a hill, with its houses and grounds situated on the broken-down hill rock. Here and there may be a patch of clay, but this only to a very limited extent; while the thorough drainage of the town has swept away every vestige of morass or stagnant pool. As noted elsewhere, the water, which in days

bygone formed open streams, and in one part was abundant enough to turn a mill, has now disappeared, and has either been conveyed below as an agent in sewerage, or arrested at the different dwellings for town or domestic purposes.

The condition of the valley does not enter materially into hygienic considerations respecting Malvern. It is mainly a rich agricultural district, and in geological language belongs to the Trias or New Red Sandstone period; the valley from Malvern to Worcester, and southward to Pendock and Tewkesbury, being covered by the soft upper beds or Keüper marls, with here and there a hill of Keüper sandstone, and large masses of drift-deposit, from some of which, even as near as the Imperial Hotel, have been obtained remains of the extinct elephant—*the Elephas primigenis.*

Vegetation, Shrubs, Plants, &c.

The vegetation of a district is probably one of the most accurate tests of climate, even more than that of meteorological data, which yet require more extended observation. Meteorological considerations, as shown in different subsequent sections, involve height, position, prevalence of winds, fall of rain, humidity, and other points, which must be taken as a whole in any climatic estimate. A writer on Climate well remarks—"In truth our meteorological tables are mere *approximations* to the actual climatic diversities; while the growth of certain classes of plants —such as cereals and the cultivated vegetables, as well as the geographical range of the hop, the vine, the walnut, and many delicate flowering plants—are far more accurate indices of the different climates of Great Britain than our meteorological observations." *

The growth of plants, shrubs, &c., we know, depends largely on soil, height, fall of rain, and exposure to adverse or genial winds; and observation and experience show that certain plants

* "Climate," Norton's "Cyclopædia of Agriculture."

and shrubs will only flourish in particular districts. The plants, for example, of a damp or boggy locality vary essentially from those which are found in more elevated positions, and on a dry and sunny soil.

The health of a district, as a general rule, may be tested by the character of its vegetation. The returns of mortality to a large extent corroborate this statement.

Under the head of *Temperature* in a succeeding section, some details will be given as to height and temperature, and also in respect to those influences on vegetable and animal life. Shrubs which barely maintain an existence in the valley beneath Malvern, or in low situations, perish during exceptionally severe weather. This was shown in Malvern during the winter of 1859–60, when numerous shrubs were destroyed in the low plains between Malvern and Worcester, while not a single specimen of the same plants suffered in Malvern itself. Dr James Williams observes, that "many exotics flourish through the winter in the open air at Malvern, which would perish by night-frosts in the valley below." Mr Edwin Lees in his "Botany of Worcestershire" observes, "Though in the severe winter of 1859–60 numerous laurestines, bays, arbuti, &c., were totally destroyed in Devonshire and Herefordshire, and also in the lower parts of Worcestershire, and rose-trees were killed by thousands, yet about Malvern scarcely any destruction of shrubs took place. This immunity from intense cold is attributable to the moderate elevation of the ground, the dryness of the atmosphere, and the absence of the fog that overspreads the valley below."*

The influence of height on temperature is strikingly illustrated in the following extract from the Rev. Gilbert White's "Natural History of Selborne," Letter cvii. :—"This strange severity of the weather made me very desirous to know what degree of cold there might be in such an exalted and near situation as Newton. We had, therefore, on the morning of the 10th, written to Mr

* "Botany of Worcestershire," 1867, p. 73.

——, and entreated him to hang out his thermometer, made by Adams, and pay some attention to it morning and evening; expecting wonderful phenomena in so elevated a region, at two hundred feet above the level of my house. But, behold! on the 10th at eleven at night it was down only to 17°; and the next morning at 22°, when mine was 10°! We were so disturbed at this unexpected reverse of comparative local cold, that we sent one of my glasses up, thinking that of Mr —— must, somehow, be wrongly constructed; but when the instruments came to be confronted, they went exactly together, so that for one night at least the cold at Newton was eighteen degrees less than at Selborne, and through the whole frost ten or twelve degrees; and, indeed, when we came to observe consequences, we could readily credit this, for all my laurestines, bays, ilexes, arbutuses, cypresses, and even Portugal laurels, and, which occasions more regret, my fine sloping laurel hedge, were scorched up, while at Newton the same trees had not lost a leaf."

Dr James Williams records a striking example of the influence of height, and other conditions on vegetation, as forwarded to him by a gentleman resident in the county of Worcester :—" On one occasion I examined the damage done to the blossoms of a pear-tree growing in the bottom of a valley, after a night's calm frost; at ten feet from the ground 96 per cent. were killed, at twenty feet above, 40 per cent., and at thirty feet elevation, only 18 per cent."

Referring the reader to data given in subsequent sections, still more fully expanding this subject, we now proceed to note some of those plants and shrubs which flourish in Malvern, but which are limited in their growth, or do not exist at all in lower or less favourable climatic districts.

In the vale below Malvern are trees evidently relics of the Malvern Chase, fine old oaks and antique elms. The elms of Worcestershire are celebrated for their size and beauty, forming noble avenues to the mansions of the district. Some of the

orchards are very fine, as for example, the Barland pear-orchard, Newland, on the way to Worcester. During the month of May the valley has a gay appearance, the trees appearing as if covered with flakes of snow, so prominent is the display of apple-blossom.

The number of phanerogamic or flowering plants in the district of Malvern, as enumerated by Mr E. Lees, extends to 807. The lower tribes, which largely characterise the Malvern flora, include ferns and equisetaceæ, 24 species; mosses, 148; fungermanniæ, 30; other hepaticæ, characeæ, &c., 28; lichens, 254; fungi, 429—total, 912.

Passing from the valley to the hill, and to the town or village of Malvern, we reach a height varying, as elsewhere stated, at from 300 to 800 feet, where a distinct soil and atmosphere very materially influence vegetable growth. These remarks are written in the month of May (1871), when Malvern throughout its length and breadth appears one garden with villas and more palatial residences interspersed. Every house has its grounds of greater or less size, studded with ornamental shrubs, with boundaries fringed with laurels and laurestines in full flower, and overhanging trees of the lilac and laburnum, the purple and yellow flowers presenting a striking and agreeable contrast to the flowering ash, the crimson and white chesnut, and the Guelder rose. The Portugal laurel (*Cerasus lauro-lusitanicus*) is now in full bloom in every garden of the town, while the laurestine (*Viburnum sinut*) flowers profusely during three fourths of the year. Hence Malvern may be correctly characterised as a place of evergreens. During the winter the gardens present more of the greenness and freshness of the summer in less-favoured localities. The sweet bay (*Laurus nobilis*), an evergreen, which in few parts of the country can stand the frost, is now in full bloom, uninjured by the severe winter of last year. The *Berberis Japonica*, and in particular the *B. Darwinii*, appear to luxuriate in Malvern soil. The strawberry-tree (*Arbutus unedo*), which in most places cannot

stand the frost, flourishes profusely in the gardens in every direction. The gum cistus (*Cistus ladaniferus*) grows more freely here, perhaps, than in most other parts of England. The beautiful evergreen *Garrya elliptica* attains to remarkable growth, and very fine examples of it may be frequently seen.

The newly-introduced privet (*Ligustrum Japonicum*) thrives well; so also do the *Magnolia Exmouth*, the *Photinia serrulata*, the ceanothus (*azureus, dentatus,* and *rigidus*), the escallonia (*macrantha* and *rubra*), and various other not common evergreens and shrubs.

Among the deciduous trees and shrubs which flourish freely in Malvern, we may mention the *Aralia spinosa* (to a remarkable degree), the *Catalpa syringæfolia*, the *Forsythia viridissima* and the *Paulownia imperialis.*

More remarkable still are the examples of coniferæ, which attain to a size and luxuriance of foliage which betokens a climate and soil favourable to special growth. First, among these we may mention the true cypress, in its rare forms the *Cipressus funebris*, the *C. Govenuana*, the *C. Lambertiana,* and the *C. Macrocarpa.* To these we may add the upright cypress, the *C. sempervirens*, and the *C. torulosa.* The *C. Lambertiana* from California appears to thrive with unusual signs of health and vigour.

The *Abies Smithiana*, a denizen of the North of India, attains to a considerable size, with evident healthy growth. The Chili pine (*Araucaria imbricata*) may be seen in most gardens, several of the plants having attained to a height of ten, fifteen, or even twenty feet, with indications of luxuriant growth. The Chilian arbor vitæ (*Libocedrus Chilensis*) is another of the coniferæ which grows very fine in Malvern; and the same remark applies to a variety of the silver fir (*Picea Webbiana*) from the North of India. Another denizen of California remarkable for its bright green foliage—the *Pinus insignis*—which can rarely stand the cold frosts of the valley, attains a remarkable size, evidently uninjured by the winter climate of the Malvern height. Probably this fine tree would grow

with equal vigour on the sides of the hill at a much greater altitude. Large and graceful specimens of the beautiful conifer, the *Picea Pinsapo*, may be seen in many of the gardens, exhibiting an extraordinary degree of growth. A fine tree of the Californian red-wood (*Sequoia sempervirens*) is in the Promenade Gardens.

Passing along the hill southwards, the sides of the range are in some parts richly clothed with trees of various kinds, but not, as in forest times, of a large growth. The autumnal furze (*Ulex Galeii*) while in blossom gives to portions of the hills a rich golden colouring, while acres of land are brilliant with the purple of the foxglove (*Digitalis purpurea*). In August, the bright colours of the *Ulex Europea* give beauty to the landscape. The southern portion of the range, richly clothed with the holly, presents a marked contrast with the treeless character of the northern extremity. Hence the name, "Holly-bush Hill." The botanist in his rambles will find many sources of interest depending on the geological formation of the district, as influencing the physiology of vegetation. The plants of the eastern side, with its soil of new red sandstone, or lias, evidence a characteristic difference from the lime-feeding plants which grow on the western side, with their silurian slopes. Among the rare objects on the eastern side may be noted the *Scirpus maritimus*, the *Rumex maritimus* and *Erodium maritimum*, which have survived the disappearance of the salt-water lakes or marshes of olden epoch, and on the western side in Eastnor Park, the Druid-oak, on which grows the sacred misletoe, of which there are only some dozen examples in England.

III.—Height and Atmospheric Pressure.

Several important climatic considerations are connected with height. Height and atmospheric pressure bear close relationship. The ordinary pressure of the atmosphere is estimated at fourteen pounds to the square inch. This pressure, however, varies more

or less according to height, being greater in lower and less in higher positions. Thus in Gastein, whose spa elevation is about 3200 feet above the level of the sea, the barometric pressure is diminished by more than three inches (24″ 5‴) and the diminution of pressure at that height has been calculated as 3000 pounds, the atmospheric ordinary pressure of the entire body being taken as 28,000 pounds.*

What are the physiological and hygienic influences induced by changes in atmospheric pressure?

Respiration is a twofold process, and involves the expiration of carbon and the inspiration of oxygen. The health of the body largely depends on its getting rid of carbon, the product of metamorphosed tissue, by union with oxygen. The due performance of this function of course depends on the amount of the latter gas in the air, and the activity of the respiratory process. Hence, the inspirited feelings which invalids or indolent persons experience on exercise in the open air during a mountain ramble. Exercise induces more active respiration, and the system feels inexpressible relief from blood oxidation.

Birds who soar in a higher atmosphere, and animals who range on Alpine heights, have lung-cells of proportionate dimensions—that is, cells capable of containing a larger proportion of air. Witness in human beings the influence of ascending a moderate mountain height, or residing in an Alpine climate. The necessity for a due supply of oxygen is imperative, but the amount of oxygen as we ascend into a higher region becomes less, hence the necessity for deeper inspiration. The pedestrian instinctively elevates his head and expands his chest, endeavouring in this way to breathe the largest possible amount of air. Thus the thoracic muscles acquire strength, the air-cells increase in elasticity and consequent expansion, and the blood becomes purified. This fact leads to the consideration of the therapeutic influence of chest expansion under ordinary circumstances, which by me-

* "On Spas and Climatic Resorts," by S. Sutro, M.D, p. 58.

chanical agencies may readily be effected in persons unable to indulge in hill rambles or mountain exercise.

The height of the Malvern residences ranges from 300 to 700 feet. The height of Townshend House, College Road, is nearly 450. The height of the main road, or central portion of the town, as before stated, is 480.

The question arises whether this elevation causes such an alteration in atmospheric pressure as to influence the function of respiration? Again, is the altered density of the atmosphere such as to exercise any effect on temperature? or how far is Malvern climate dependent on the prevalence of certain winds, and to what extent are wind currents influenced by the position of the hills and by other circumstances.

The influence of a change from a lower district, even from some of our deservedly celebrated watering-places, so beneficial in their effects on some invalids, to Malvern is remarkable. It is common to hear persons speak in warm terms of the exhilarating influence of the change, an influence, as experience shows, not of a temporary character. Such persons tell us that they breathe "another atmosphere," one which inspires them with new life and energy. As different atmospheres are beneficial to different constitutions, so they may be equally beneficial in different stages of disease. An atmosphere of moderate height and pressure may be most suitable at one stage of disease, but in another a change may be equally desirable.

In reference to the hygienic influence of height, however, our knowledge is at present imperfect. We must wait for additional evidence before we can arrive at definite medical conclusions. The Alpine summer resorts range upwards of 5000 feet, and one of them, the Bernina Pass, 7600 feet. These form a remarkable contrast to the moderate height of Malvern, and the difference in elevation must exercise a considerable influence on the respiratory function. Extended observations will probably afford us data as to the precise medical influences of atmospheric pressure, and

consequently to some extent of the medical influence of height. Height, however, involves other considerations than those of atmospheric pressure, as, for example, exposure to cutting and chilly winds. While admitting the high value of some of the Alpine resorts, Dr C. B. J. Williams speaks of one (Pontresina), "from its exposed situation, open to north and east, and its promixity to the snow mountains and glaciers of the Bernina range, as wholly unsuited to invalids, even in summer;" of others (Silvaplana and Camfer), as "draughty and liable to evening chills from the sheets of cold water;" of a third (the Kurhaus of St Moritz), as "open to every wind that blows, and even in the summer it must be both damp and draughty;" and arrives at the conviction that the Upper Engadine is too high and too cold, even in the summer, for the comfort and well-being of delicate invalids, and even of some persons in health;" and it becomes a question, he continues, "whether sufficiently cool and bracing summer resorts may not be found at a somewhat lower elevation, and so accessible, and with such comfortable accommodation, as to make them available." With respect to the climate of the Bernina district (7600 feet high), he observes—"it is a bleak, dreary spot, more suitable to Alpine Club men than for invalids."*

These and numerous other illustrations which might be adduced, show that height involves other and potent hygienic considerations, and amongst the most important of these may be included temperature, humidity, and wind currents.

In forming, therefore, an estimate of the superiority of Malvern climate, we must look for it not in one, but in a combination of causes, and test it by the more unerring results of experience. The height is moderate, but sufficient to isolate it from any injurious valley influences; the aspect is largely eastern, but it receives the genial warmth of the morning sun; the fall of rain may be as great as in many other places, or even greater, but it rapidly percolates the gravel and descends to the lower levels; the

* Dr Charles J. B. Williams, *British Medical Journal*, 1869, p. 577, 578.

winds are at times boisterous, but rarely if ever as severe as in numerous other health-resorts. We may content ourselves with the fact that, as a whole, the climate of Malvern is eminently hygienic, and we may reasonably extend our inquiries to such meteorological and other investigations as will lead us to practical results.

IV.—Temperature.

The observations made in the previous section equally refer to this division of our subject. The climate of Malvern during the winter and spring months is not severely or intensely cold, nor, as we shall elsewhere show, is it damp or chilling. It has, on these and other grounds, strong claims for consideration as a winter residence.

Is an elevated position, where the air is less dense, colder than the more sheltered valley below? Experience testifies to the contrary, and some recent experiments of Dr Marcet, made during an expedition to the Mont Blanc chain of mountains, show that the temperature of the human body in a state of repose does not ordinarily become less elevated at the summit of high mountains than at the level of the sea. The act of ascent, however, progressively diminishes the temperature of the body, and in particular, rapid mounting and free transpiration. The experiments of Dr Marcet were made in positions greatly more elevated than that of Malvern, but still they prove that, in a state of repose, diminution of atmospheric pressure does not induce diminution of animal temperature.

Height and diminution of atmospheric pressure not inducing a diminution of animal temperature, what other causes contribute to induce the generally genial and equable climate of Malvern?

A sunny and exposed aspect forms an important item in this estimate. A full exposure to the rays of the morning sun, is a potent source of atmospheric and terrestrial warmth. The influence of sunlight on the vital functions is highly hygienic, and

a source of great benefit to invalids. Its effects on the pulse, and consequently on animal temperature will be noted in a subsequent section. The comparative freedom from chilling winds constitutes another cause of the equable climate of Malvern. This point will receive full consideration under its appropriate head.

The absence of long-continued mists and fogs, and consequent comparative dryness of the atmosphere, is also a prominent cause. The *feelings*, as experience testifies, even to persons in ordinary health, abundantly indicate the state of the air. Damp air is a good conductor of heat. Hence the body loses its heat more rapidly in a moist atmosphere than in a dry one. It is on this ground that an individual feels more chilly during the breaking up of a frost, even when the temperature is many degrees warmer. The cold during frost is more intense, but the air more dry.

The drainage of Malvern, natural and artificial, exercises much influence on its temperature. The prevention of local accumulations of water, and consequent dryness of the soil, prevents that constant evaporation which is only another term for coldness. A perpetual mist is a source of perpetual chill, not merely in consequence of the rapid loss of heat from the body, but from the cooling influence of evaporation.

The verdure on the Malvern hills, which contributes to give them so great a charm, doubtless exercises some influence in giving to Malvern so equable a climate. Plants do not retain so long the solar heat as the bare soil or rocks. The thinness of the leaves, and their consequent contact with the air, quickly deprives them of their superfluous heat. The atmosphere, if colder, gains, and vegetation loses caloric. Hence in a district covered with vegetable growth, the heat is more equably distributed during the twenty-four hours. During the day the heat is less intense. During the night the cold is less severe. The reverse is the case in districts where the soil or rocks are bare of vegetation. There is little doubt that if the Malvern hills were bare, the cold of *winter* would be more severely experienced.

Sheep and other animals prefer during the night to rest on the upper crags or rock eminences. They instinctively avoid exposure to the severe cold caused by the vapour and chilling damps of the low lands beneath.

During severe winters it is well known that in the valley between Malvern and the Severn vegetation suffers greatly, while the same shrubs in the Malvern village flourish altogether uninfluenced. In the severe winter of 1860 the destruction of the *Araucaria imbricata* in the valley near Worcester was very serious, while not a single shrub of this species was destroyed in Malvern. The valley in fact forms a basin into which flows the currents of cold air which descend from the hills. "The air," observes Mr Buchan, "in contact with the declivities of hills and rising ground becomes cooled by contact with the cold surface of the ground; it acquires greater density and weight, and consequently slips down the slopes, and accumulates in the low-lying ground at their base." Such places, as this writer observes, are never exposed to the full intensity of frosts. Their height provides in a large sense for the escape of the cold as fast as it is produced, while the valley beneath not merely forms a reservoir for the cold which descends from the adjacent heights, but retains its own cold of radiation. Mr Buchan informs us that "along most of the water-courses of Great Britain, during the memorable frost of Christmas 1860, laurels, araucarias, and other trees growing below a certain height were destroyed, but above that height they escaped; thus attesting by unmistakable proof to the great and rapid increase of the temperature with the height above the lower part of the valleys." *

It is probable that terrestrial radiation will to some extent account for the destruction of vegetable life, as referred to in previous paragraphs; for low temperature, as before stated, is not absolutely the cause of the destruction of plants. A temperature, for example, of 4° below freezing-point, *having the same tempera-*

* "Handbook of Meteorology," p. 101.

ture on the ground, will not be detrimental to vegetable life, even to many comparatively delicate and sensitive plants. If, however, the temperature of the ground should be 4° below freezing-point, and the temperature of the air 4° above freezing-point, constituting a difference of 8°, the low temperature of the ground must be pernicious, if not destructive. In this case, the mischief caused will arise from the difference of the temperature of the ground or soil from the temperature of the atmosphere above it.

One cause of the comparative warmth of Malvern arises from the circumstance that its houses are built at the base and on the side of a hill which protects it from certain winds, especially the westerly, and in a large measure from the north winds. The east winds chiefly direct their influence above the elevation of the houses, at least the great proportion of them. Besides, as will elsewhere be shown, the east winds of Malvern are not peculiarly cold nor moist. To some extent the town is protected from descending currents of cold air by the plantations of trees which flourish on the upper slopes. The climate of England unquestionably grows warmer, and the influences of cold on the human body, to travellers, at all events, have greatly decreased.

Increase in atmospheric warmth may be attributed partly to improved drainage, and, in towns, to the caloric imparted to the atmosphere by masses of individuals living in close contact, and the proportionate use of fires in domestic houses and in manufactories.

In various ways, also, man is less exposed to the injurious influences of cold. He is better clad, and therefore more efficiently protected from atmospheric changes: his dwellings are better built, and his means of locomotion are greatly facilitated. On the other hand, bodily exercise has been equally diminished. The journey on horseback, or in carriage, which occupied some three hours each twenty miles, is now accomplished by railway in less than one, and with trifling physical exertion. The comparative exclusion from cold in railway travelling constitutes another im-

portant item in respect to climate. How different the mode of locomotion in former times, when the farmer and his wife went to market on the horse, or the country gentleman in an ill-constructed carriage! The travelling carriages of the present day and the railway, in their aggregate influence, almost make a difference of several degrees in climate, while the aggregate diminution of bodily exertion must be proportionate. The demand for food is of course lessened; and hence, in modern times, a change in our habits of diet has taken place which contrasts remarkably with those of our ancestors,—a change which is attributable not so much to caprice or fashion, as to difference in climatic exposure, and consequent physiological requirements.

The tables of the Messrs Burrow, so accurately and laboriously prepared by Mr Wood, superintendent of their meteorological department, make the mean temperature of Malvern seasons during three years, ending the winter quarter, March 19, 1870, as follows:—

Spring.	Summer.	Autumn.	Winter.
51.1	61.4	47.9	40.3

Dr Addison, formerly for many years a resident in Malvern, and Dr James Williams, both painstaking and careful observers, have each published the results of records during several years. These we are enabled to compare with the more recent observations of Messrs Burrow.

MEAN TEMPERATURE OF THE SEASONS IN MALVERN.

	Spring.	Summer.	Autumn.	Winter.
Addison, . . .	47.0	59.8	50.1	41.3
Williams, . . .	47.1¾	59.1½	49.9	40.0
Burrow, . . .	51.4	61.3	47.9	40.3

It will be observed in these observations there is little difference noted in the winter quarter; but in the tables of the Messrs

Burrow the autumn quarter is lower, and the spring and summer higher.

In July 1868, the heat throughout the kingdom was extreme. The following table exhibits the maximum temperature at a few well-known places, as registered on the same day:—

Great Malvern,	91.0	London,	93.2
West Malvern,	95.5	Tonbridge,	100.5
Nottingham,	97.3	Cheltenham,	97.0

The moderate temperature thus noted was doubtless attributable to the free circulation of air, induced by those genial breezes which seldom merge into boisterous or cutting winds. A record of the direction and force of the Malvern winds will be seen in a subsequent section. The following table for each month in the year has been prepared from the published reports of the Messrs Burrow.

MEAN TEMPERATURE OF EACH MONTH IN THE YEAR.

	1867.	1868.	1869.	1870.
January,	...	37.5	41.0	38.6
February,	...	43.1	44.7	36.6
March,	...	44.8	38.8	40.3
April,	49.2	48.8	49.4	49.6
May,	53.3	57.0	48.7	53.8
June,	58.2	60.9	55.1	59.4
July,	60.1	66.1	63.2	65.7
August,	62.0	61.9	60.5	62.8
September,	57.5	58.5	57.8	58.3
October,	49.6	48.0	50.0	50.6
November,	41.8	41.0	43.9	42.5
December,	38.8	44.9	37.6	33.8
		Mean 51	Mean 49.2	Mean 49.3

V.—Humidity or Dryness.

What are the conditions which induce dryness or humidity in a district, and what causes exercise a special influence on Malvern climate?

Sir James Clarke, in his work on the effects of climate in disease, remarks :—"Humid and confined situations, subject to great alternations of temperature between day and night, are the most dangerous; dryness, a free circulation of air, and a full exposure to the sun, are the material conditions to be attended to in choosing a residence. Of all the physical qualities of air, humidity is the most injurious to human life; and therefore, in selecting a residence or situation for building, in all climates, particular regard should be had to the circumstances which are calculated to obviate humidity in the soil and atmosphere."

Although Malvern has been distinguished for a considerable period as a health-resort, unquestionably of late years, from various causes, its climate has been less moist. Centuries back, the whole district between the hills and the Severn was one vast forest, with probably much swampy land. The trees of the forest would at this period extend some distance up the hill-side. Piers Ploughman, in his "Vision," is described, when weary of the world and its vices, as falling asleep by the side of a stream on the "Malverne Hilles," a stream so strong, that it "sweyed" (sounded) "meerye" (merry). This celebrated poem was written about the year 1362. The stream described by the poet was probably one of those copious rills, which even in comparatively recent times flowed down the hill-sides, and supplied the village with abundance of water. One, or a combination of these, gave the name to the newly-widened road leading to the Parochial Schools and Christ's Church—Mill Lane. The remains of the old mill which was turned by this water were in existence little more than twenty years ago. Within a limited period the greater portion of Southfield, including the ground on which Townshend House stands, and also the College grounds, was a wood used within the memory of man for sporting purposes.

The district in the valley below Malvern would, in remote times, be comparatively a morass. The old guide-books state that, at a bygone period, charitable ladies at the Priory Church

were accustomed to distribute to the poor, after Sunday-service, packets of bark as a remedy for those afflicted with ague or fever. These days have vanished before the drainage and other improvements of modern farming.

In a low district the air is often loaded with moisture from a lake or river. Under such circumstances, the influence of a heavy fall of rain is very perceptible, and shows a continuous humidity for two or three nights, not unfrequently approaching to saturation. A heavy fall of rain in Malvern, however, may, and generally is, followed for days with a low degree of humidity.

The absence of a large amount of foliage, such as formerly existed even on the hill-side, is doubtless one cause of the relatively limited humidity of the Malvern climate.

Another and probably more potential reason is, that although the *fall* of rain is equal to that in many other decidedly less healthy portions of England, the situation of the town on a declivity, and hence its natural, combined with very efficient artificial, drainage, prevents that local accumulation of moisture which would otherwise be a source of evaporation and consequent cold. Half a century back, Malvern was a village of some fifty houses; but now its hundreds of villas require a supply of water, and tap the hill sources so freely, that the streams from the heights, bounteous as they are, are too vigorously intercepted to be permitted to unite in sufficient force to turn a mill. The effects of drainage in diminishing humidity in some agricultural districts are very remarkable. In certain localities, drainage is said to be overdone, and to exercise a prejudicial influence. Probably in these places a deficiency of water as much arises from the cutting down of timber as the drainage of the land. In South America and in the East some very illustrative observations have been made. In districts of land which have been subject to cultivation, lakes have been gradually diminished in their size, and portions of their shores have been left dry. Civil war and its desolating influences having caused a depopulation of

the land, and consequently its cultivation, forests again have made their appearance—for in tropical climates the growth of vegetation is rapid—and the formerly cultivated land by the lake-side has again been submerged. The channel of the Euphrates is being contracted by the demolition of the forests; while, on the other hand, the sandy deserts of Egypt are giving promise, when fertilised by an abundant supply of water, of becoming fruitful gardens and "blossoming as the rose." The fall of rain in North America diminishes as the forests disappear; while in Egypt, as the cultivation of the palm-tree increases, the fall of rain becomes proportionately copious.

Recently (1870) information has been published which conclusively shows the influence of tree-denudation on climate in Australia. In the Ballarat district the destruction of the timber has been accompanied by a corresponding diminution in the rainfall; and since 1863 there has been a more or less regular reduction from 37.27 inches in 1863 to 17.23 inches in 1868. During seven months of the year 1869, and including two of those ordinarily the wettest, the rainfall was only 11.20 inches. These facts have induced the Government to appoint an inspector of State forests, to prevent the waste of timber and the reckless destruction of live wood, and at the same time to establish nurseries of forest trees in various parts of the Colonies.

These facts show that it lies within human limits to alter or modify the weather, not merely in districts, but throughout the length and breadth of the land. The climate of England has undergone a considerable change within the last half century, and the humidity and temperature of districts have from combined causes been subjected to considerable modification. This fact will be more clearly seen when some additional influences bearing on Malvern climate are brought under consideration.

Height unquestionably exercises an influence on the humidity of the atmosphere. Long-continued rains are more frequent in areas of low pressures than in the more elevated districts.

VI.—Winds.

The following is a tabular view of the wind-currents in Malvern during the greater portion of the last four years :—

1867.		1869.	
April,	W.N.W.	January,	S.W.
May,	S.S.E.	February,	do.
June,	N.N.W.	April,	do.
July,	N.W.	July,	do.
November,	do.	September,	do.
December,	do.	August,	S.W.—N.W.
August,	S.W.	March,	N.E.
September,	do.	May,	N.E.—S.E.
October,	do.	October,	N.W.
		November,	do.
		December,	N.W.—S.W.

1868.		1870.	
January,	S.W.	January,	S.W.—N.W.
March,	do.	April,	S.W.
April,	do.	May,	do.
May,	do.	July,	do.
December,	do.	September,	do.
February,	W.N.W.	October,	do.
August,	do.	November,	do.
October,	do.	February,	N.W.
June,	N.W.	June,	do.
November,	do.	August,	do.
July,	N.E.	March,	N.E.
September,	N.E.—S.E.	December,	N.

The prevailing winds, as shown in the above tables, are north-west and south-west. The east winds, supposed to prevail in Malvern, do so only to a very limited extent. In 1867 the S.S.E. winds prevailed in May only. In 1868, the N.E. in July; and in September, the N.E. and S.E., that is, only during two months; and in 1869 again only during two months, *i.e.*, in March and May, the winds were N.E., and N.E. and S.E. During the other months the prevailing winds were N.W. and S.W. In 1870 the absence of the east winds is very marked. The N.E.

winds prevailed in that year during the month of March only, nor were they at all severe.

It is interesting and important on hygienic grounds to ascertain the bearings of winds on temperature and humidity.

During May in 1867, when the S.S.E. winds prevailed, the mean temperature of the air was 53.3. In 1868, when the east winds prevailed in July and September, the temperature of the air in July was 66.1, and in September 58.5; while in 1869, during the prevalence of the east winds in March and May, in the former month (March) the temperature was 38.8, and in May, 48.7. Here we have proof that the Malvern east winds do not bring with them any extraordinary degree of cold.

In reference to humidity, in May 1867 it was 72; in 1868, in July and September, 59 and 73; and in 1870, in March and May, 77 and 79. In each of these months during 1867 and 1868, the humidity in Bournemouth and Greenwich considerably exceeded that at Malvern.

The Malvern east winds, as shown in the above records, are neither cold (one exception only, *i.e.*, March 1869) nor dry—the humidity of the months during which they occurred being only in one instance so low as 59, and in the others 72, 73, 77, and 79 respectively.

Mr Buchan, in reference to the east winds of Great Britain, observes, "These winds prevail, as is well known, in spring. They are always dry, but in some years, as in May 1866, they reach an almost unprecedented dryness, such low humidities as 44, 37, and even 29, having been observed at many places in Scotland, at nine in the morning. The deleterious influence of the east wind is shown not only in the discomfort and uneasiness it gives to the less robust amongst us, but also in the largely increased number of deaths from consumption and brain diseases which it causes."*

The atmosphere of the east wind contains less moisture, and

* "Handy Book of Meteorology," p. 233.

it is rarely associated with rain. Hence, easterly winds are ordinarily dry and cutting, checking the circulation of blood on the surface, and inducing those conditions of congestion on the inner or mucous membranes which are so fatal in England during cold seasons. The east winds of Malvern, however, as shown above, are not dry ones, a circumstance deserving of special reference.

The south-east wind, however comparatively mild in winter and spring, is dry and oppressive during summer. Its influence on animals, in inducing thirst and feverishness, and on vegetables, in the shrivelling up of their leaves, is well known; nor are its effects less depressive on the animal functions. It has been noted that certain epidemic diseases, such as Asiatic cholera and influenza, make their appearance during the prevalence of the south-east wind; and recent investigations tend to show that air animalcules or vegetable parasites are generated in or conveyed by particular winds, and, during special seasons of the year, giving rise to well-known forms of disease—as, for example, the hay-fever.

Hygrometic changes, as elsewhere observed, exercise considerable influence on our feelings, and this to a remarkable extent on persons subject to dyspeptic derangement, and with highly sensitive temperaments. The effect of humidity in causing the leaves and flowers of plants to open or contract is well known; and undoubtedly moisture and dryness exercise considerable influence on living animal fibre. The absorption of moisture by the skin, and its abstraction by drier conditions of the atmosphere, induces feelings of disquietude and pain, exhilaration and pleasure. A change in bulk, induced, on the one hand, by absorption of moisture, and on the other, by its abstraction, will explain these influences. In persons of highly sensitive nerves, or in parties subject to rheumatic tendencies, the slightest hygrometic variations are felt,—and with this class of persons a change of weather is early and unerringly prognosticated.

From these and other considerations, it will be seen that *equableness of temperature* is an essential element in the selection of climate by an invalid. Many feeble and delicate persons live in comfort and comparative health in a relatively cold climate, provided that the atmospheric changes are not sudden or severe. Exposure to chilling winds, to cold transitions,—in particular cold and damp,—these influences induce those changes in the body which are so destructive to life. The mean annual temperature of places may be identical or nearly so, but the atmospheric variations may essentially differ. This constitutes the value of special climates, and one of the important advantages of Malvern.

THE INFLUENCE OF WINDS ON HEALTH.

In what respects do winds differ in their force, direction, &c., in their influence on health? Winds it is well-known are occasioned by variations in atmospheric pressure. And this pressure, and consequently the direction of winds, depends on the humidity or dryness, the coldness or warmth of the air.

Much of course has relation to the condition of the earth's surface over which the wind passes. In Europe the easterly winds are dry, while the westerly winds are moist. Hence various hygienic influences, and no less important medical considerations.

The atmosphere, for practical consideration, may be considered under two divisions—dry air or gaseous envelope, consisting of oxygen and nitrogen; and an atmosphere of vapour, or water in a state of greater or less condensation.

On the intermixture of these two atmospheres depends those conditions of the air which we term climate, and which exercise so large an influence on health.

Dry air is stimulant and tonic. It stimulates the functions to increased activity. It favours cutaneous evaporation, rapidly withdrawing moisture from the skin as well as the air passages, and thus compels internal efforts to restore the abstracted fluid. A certain degree of moisture of the skin without and the

mucous membrane within is essential to the performance of their functions.

Dry air, then, to a limited extent, is tonic. In special relaxed conditions of the system, where the blood is low and the functions are feeble, it acts as a genial stimulant, and energises the functions. Probably these effects are more or less attributable to electric influences. Dr C. J. B. Williams enumerates, among other properties of dry air, in moderate degrees and at mild temperature, "facilitating the purification of the blood in the lungs," "improving the tone of the moving fibre," "checking tendencies to excessive secretion," "counteracting various septic processes both within and without the body which are generally promoted by humidity;" while it forms "one of the best safeguards against the activity of miasmatic poisons." *

Moist air has its distinct general physiological characteristics. It contains, of course, a less amount of oxygen than dry air, and has a less power of lung-diffusion. It therefore less oxygenises the blood, and is less stimulant and tonic. In conjunction with warmth, it relaxes the skin and promotes perspiration. Hence danger from evaporation by sudden chills or adverse currents. Moisture is well known to be favourable to animal or vegetable decomposition. It also tends to favour infection. Cold, in conjunction with moisture, is still more injurious to health. It is equally fatal to vegetable life.

The influence of cold, and in particular of cold in association with damp, in the production of disease, and in the destruction of life, is abundantly proved by the bills of mortality. What are the special pathological influences induced by cold and damp? The influence of moist air on respiration has been already noticed in combination with cold. Its abstraction of heat from the body is very rapid, and its consequent draw on the vital energies. Among other effects will be those which check the functions of assimilation. Hence certain chemical results, such as the re-

* "Principles of Medicine," p. 483.

tention of lactic acid in the blood, and the formation of oxalic acid in the stead of lithic, and the formation of various blood and other diseases. Among these Dr Williams enumerates "rheumatism, neuralgia, sundry cutaneous affections, cachectic ulcers, tubercles, scrofula," &c.*

The comparative freedom of Malvern from a moist atmosphere probably is one cause of its known remedial influence in scrofulous conditions of the blood, and in ulcers and other cutaneous affections. To this fact more special reference will be made in another section.

Add to these considerations the fact, that inland air has not less than 20 per cent. more evaporating power than sea air (*Dr Burdon Sanderson, British and Foreign Medico-Chir. Review*, Jan. 1856). Conjointly we have also the statistical evidence of the tables of mortality, which show that inland watering-places are more healthy than sea-side localities, proofs of which will be adduced in a subsequent section.

While, however, equableness of climate within certain limits is desirable, it must not be forgotten that *motion* of the air is decidedly useful in dispelling noxious influences. Air currents, to a limited extent, are health preservers; healthful in diffusing and rendering comparatively harmless miasmatic exhalations; healthful in relation to the electric conditions of the atmosphere; and healthful in their influence on the animal functions. To live in the same atmospheric medium, to the special invalid may be agreeable and beneficial, but to a person in ordinary health the same climate during the entire year would be the contrary of sanitary and tonic. The winds and storms, of which we too frequently complain, are messengers of mercy, and induce changes, both atmospheric and physiological, which are eminently conducive to health. Rain may be said to wash the atmosphere, wind currents to disperse noxious or miasmatic exhalations, which in certain localities might otherwise be stationary. These re-

* "Principles of Medicine," p. 486.

marks also hold good even to invalids, if, by artificial means, such as efficient clothing and house accommodation, they can secure themselves from the immediate and direct influences of elemental warfare. Delicate and even consumptive patients take their daily walks during the cold of winter, and in defiance of rain during the summer months, with manifest advantage, provided they preserve an equable temperature by adequate clothing and exercise, and prevent, by similar protection, dampness or coldness of the feet. It is not the cold that kills, provided it is equable. It is adverse cutting winds that are destructive to life, when the body is insufficiently protected. Some of the most remarkable cures which have occurred in the author's practice have been in patients who, with sufficient prudence, have persevered in their daily walks, and braved the atmospheric elements.

VII.—The Water.

The water of Malvern may be considered under two heads—the Chalybeate, and the ordinary hill-water of St Ann's Well, Great Malvern, and the Holy Well, Malvern Wells.

THE CHALYBEATE SPA.

The chalybeate spring, Spa Cottage, near to Swan Pool, was in olden times an attraction to invalids. Beyond its ancient reputation little, however, can be said of its virtues, inasmuch as we have no accurate analysis of its constituent parts. It contains a small proportion of iron in the form of a protocarbonate, which may be taken with advantage by a class of anæmic invalids. Dr Addison, long an eminent medical resident, remarks: —"In all the earlier stages of tuberculous cachexia, of scrofula, and chlorosis, and in the various forms of functional debility without fever, the results of acute disease, this mild chalybeate, in conjunction with pure air, and the constant use of a pure

water, has been very frequently a powerful agent in the restoration of health; a great many persons have received benefit from it, even when unable to bear a stronger water of the same kind—as the Tunbridge Wells and others."

ST ANN'S WELL.

The following accurate analysis of the water of the well is taken from a paper read before the Royal Society of Dublin, January 10th, 1859. It gives the minute constituents of the spring:—

Analysis of the water of St Ann's Well, Great Malvern, Worcestershire, England, by Sheridan Muspratt, M.D., F.R.S. Ed., M.R.S.A., &c., Principal of the College of Chemistry, Liverpool.

The water flowing from the well is extremely bright and cold, having a mean temperature of 48°. It is very agreeable to the taste. The specific gravity of the water is 1·0013, and the composition, tabulated from results obtained in my laboratory, is appended:—

	In the Imperial Gallon.
Carbonate of lime (Cr O, C O_2)	0·4310
Carbonate of magnesia (Mg O, C O_2)	0·4111
Carbonate of iron (Fe O, C O_2)	0·0331
Carbonate of soda (Na O, C O_2)	0·2844
Sulphate of lime (Ca O, S O_3)	1·1521
Sulphate of soda (Na O, S O_3)	0·4382
Chloride of sodium (Na Cl)	0·8768
Chloride of magnesium (Mg Cl)	0·1448
Iodide of potassium (K I)	Traces
Silicic acid (Si O_3)	0·2057
	3·9772

Dr Muspratt observes, "This spring has for years been renowned as highly advantageous as an external application to indurated scrofulous tumours, ulcers, and many eruptive diseases; as well as efficacious and beneficial when taken internally, for acidity, dyspepsia," &c.

THE HOLY WELL—MALVERN WELLS.

The following is a minute and accurate analysis of this celebrated spring :—

Analysis of the water of the Holy Well of Malvern Wells, Worcestershire, England, by A. N. Tate, Student in the Liverpool College of Chemistry.

(Read before the Royal Society of Dublin, January 10th, 1859.)

The water is very pure, containing only 6·4182 grains of solid matter in the gallon. It is beautifully clear and transparent, and its taste cool and pleasant. The temperature is 46° Fahr., and the flow of water from the spring is two gallons a minute. It has an alkaline reaction upon reddened litmus paper. Its specific gravity is 1·0012.

I have arranged my results in a tabular form, as being more convenient for reference. The following table gives the quantity of each ingredient contained in 1000 parts, and in one gallon, respectively :—

1. Total Amount of the Several Ingredients. Total Residue.

	Water employed.	Residue obtained.	Amount in 1000 parts.	Amount in One Gallon.
1.	28,000 grains.	2·600 grains.	·0928	
2.	28,000 „	2·531 „	·0903	
			Mean 09145 = 6·4185 grs.	

The following table gives the amount of the different salts in 1000 parts, and one gallon respectively :—

Carbonate of lime ($Ca\,O, C\,O_2$) . . .	·014640	1·02480 grains.
Carbonate of magnesia ($Mg\,O, C\,O_2$) . .	·021200	1·48400 „
Carbonate of iron ($Fe\,O, C\,O_2$) . . .	·003110	0·22470 „
Carbonate of soda ($Na\,O, C\,O_2$) . . .	·013330	0·93310 „
Sulphate of lime ($Ca\,O, S\,O_3$)	·023670	1·65690 „
Sulphate of soda ($Na\,O, S\,O_3$)	·001380	0·09660 „
Chloride of sodium ($Na\,Cl$)	·013510	0·94570 „
Silica ($Si\,O_3$)	·002750	0·19250 „
Alumina ($Al_2\,O_3$)	Traces	Traces
Original matter	Traces	Traces
	·093732	6·55859 „

The influence of a residence in Malvern, in certain forms of disease, has been long a matter of historical record. The

Malvern springs are thus eulogised in an old and quaint song, written about 1590 or 1600:—

"Out of that famous hill
There daily springeth
A water, passing still,
Which always bringeth
Great comfort to all them
That are diseased men,
And makes them well again
To praise the Lord.

"Hast thou a wound to heal,
The which doth grieve thee?
Come, then, unto this well,
It will relieve thee;
Noli me tangeres,
And other maladies,
Have here their remedies,
Praised be the Lord!

"To drink thy waters' store,
Lie in thy bushes,
Many with ulcers sore,
Many with bruises,
Who succour find from ill,
By money given still—
Thanks to the Christian will,
Oh, praise the Lord!"

To "lie in the bushes" was a somewhat primitive mode of seeking benefit from a residence in Malvern, and indicates not a very severe climate. Chambers, in his "History of Malvern," 1817, informs us that during one season "a lady of rank and fashion, with her equipage and servants, were obliged to be sent to the workhouse," an establishment at that time situated at the upper portion of Malvern Links. At this period the number of houses was limited, and the accommodation for visitors very small in comparison with the present date.

Our quaint poet also tells us that Malvern water, on account of its supposed or real medicinal virtue, was at this early period

(nearly 300 years ago) sent in bottles to various and distant portions of the kingdom.

"A thousand bottles there
Were filled weekly,
And many costrils rare,
For stomachs sickly;
Some of them unto Kent,
Some were to London sent,
Others to Berwick went—
Oh, praise the Lord!"

The cases of benefit of which mention is made in old writers, include conditions of general debility, and especially strumous affections, ranking among these numerous instances of old and inveterate ulcers. In the verses quoted above, the lines occur—"Hast thou a wound to heal?" and "Many with ulcers sore," indicating the favourable influence of Malvern water and Malvern air on this class of maladies. In the Addenda to Camden's "Britannia," we are told that "there is another spring called Holy Well, hitherto much resorted to for curing all scorbutic humours and external ulcers, by bathing and drinking of the waters." Dr Wall and various other more recent writers, give many interesting records of the healing virtues of Malvern water, on old and apparently incurable ulcers. Dr Wall's treatise was first published in 1756, and a third edition was issued in 1763. Dr M. Wall issued subsequently a treatise on the Malvern waters, in which are enumerated seventy-six cases in which eminently beneficial effects were found to result from the internal and external use of the Malvern waters. "The cases," observes Dr Wall, "I shall mention, are such only as I have attended myself, and therefore I will be answerable for their veracity. The Holy Well water appears, from every day's experience, to be possessed of all the virtues attributed to it, and to be serviceable in scrofulous cases, old ulcers and fistulas, obstructed glands, disorders of the eyes and eyelids, nephritic complaints, cutaneous disorders, &c. &c. The cures

performed by this water in scrofulous cases are very numerous and surprising." Previously to the issue of the work of Dr M. Wall, an analysis of the waters of the two Malvern wells had been published by Dr Wilson Philip. Even at that period (112 years ago), a modified "water cure" was successfully practised. Dr Wall gives the case of Mrs Jones, the wife of a clergyman, who came with her husband to Malvern in the year 1758, "with a large ulcerated cancer in her left breast, and a sore as large as the palm of the hand, and a discharge constantly going on, attended by terribly lacerating pains." "I ordered her," observes Dr Wall, "to drink large quantities of water, and over the dressings of the cancer were applied *linen cloths dipped in water only.*" In this case, whatever the nature of the disease, a cure was effected. Dr Wall also relates the cases of James George and Elizabeth Price, both afflicted with leprosy. In these cases, the patients, during their visit to the spring, dipped their linen in the water for a series of weeks—dressing the wounds, in fact, with wet linen; using what, in modern medical phraseology, are termed "water dressings." Another case, "King's Evil," William Richards got quite well by drinking the water, bathing, and constantly dressing the sores with cold water. Dr Wall, in his treatise on Malvern water, remarks, "I always advise my patients to drink freely of the water for some days or weeks before they use it externally. The empirical method of application, which has hitherto been successfully practised, is to wash sores, tumours, &c., under the spout several times in the day, covering the part afterwards with cloths dipped in the same water, and moistened from time to time as often as they grow dry. Those who bathe also for cutaneous foulness, usually go into the water with their linen on, and dress upon it wet. This method, odd as it is, has never yet, as I have heard, been attended with any ill consequences, though I have known it used by several very tender persons."

Mr Horner, in his "Geological Essays," on the authority of

Mr Wallet, surgeon of Great Malvern, states that "a spring on the western side of the Herefordshire Beacon, known by the name of Walm's Well, had been long used by the country people as an outward application in cutaneous diseases."

More recently, one of the most valuable contributions to the medical topography of Malvern was published by Dr Addison, F.R.S., in 1836, the result of years of careful observation during a residence in the place.

Dr Addison observes:—"With respect to their medicinal virtues, I can in a very decided manner add my testimony to the benefits derived from the use of the Malvern waters, both externally and internally, in scrofulous glandular swellings, and in chronic scrofulous ulcerations. It has frequently happened to me to see young persons of either sex, with five, six, or more, old fistulous sores about the neck and angle of the jaw, entirely cured in three or four months, by allowing the water to trickle (or rather fall down) from the spout upon them. At first this is of course productive of considerable pain from the coldness of the water, and can be borne only for a few minutes; but I have seen persons, after a little time, able to keep *the neck* under the spout for fifteen or twenty minutes twice a day. Similar ulcerations about the joints heal by the same treatment. Even in cases where the ulcers and fistulous openings are kept up by disease of the bones, the air, water, and situation of Malvern, often effect a great and marked improvement, and sometimes a perfect cure." *

Alluding to the cases recorded by Dr Martin Wall, Dr Addison remarks that, although his experience did not in all respects coincide,—"I have witnessed many obstinate cases of lepra and psoriasis much ameliorated, and some entirely give way to the liberal external and internal use of the water; and I

* Transactions of the Provincial, Medical, and Surgical Association, vol. iv. p. 94.

have also observed other cases where it has failed of doing good." *

The benefit of certain Malvern springs in affections of the eyes, has been recorded by various authors. In Bannister's "Breviary of the Eyes," printed 1622, occur the following lines :—

> "A little more I'll of their curing tell,
> How they help sore eyes with a new found well ;
> Great speech of Malvern Hills was late reported,
> Unto which springs people in troops resorted."

In the Addenda to Camden's "Britannia," we are told :— "Near the division (betwixt Worcestershire and Herefordshire), is a spring that has long been famed for the virtue of healing eyes, and other parts of the head, therefore called Eye Well." Dr Addison says that the "springs" mentioned in "Breviary of the Eyes," were the waters of St Ann's Well at Great Malvern, and of the Holy Well in the parish of Hanley Castle, now called Malvern Wells. He observes that "the common people extol the use of the waters in inflammation of the eyes ; and in some of the simpler cases they are often serviceable as a cooling external application. At Malvern Wells there is a spring called the Eye-Well." †

The spring on the walk from the Malvern Wells road, by the public baths below Kenilworth House, called the Hay-Well, is evidently the Eye-Well of olden times. Within a recent period, it was a rustic spring, very sweetly situated ; but modern innovation has not at all improved its appearance, or rendered it more attractive to visitors.

Time advances, and our records and observations extend to the present period. The resident population of Malvern has largely increased, and its invalid visitors are now numbered by thousands. Medical observation, of course, has been correspond-

* Transactions of the Provincial, Medical, and Surgical Association, vol. iv. p. 96.

† *Ibid*, p. 95.

ingly large. Chemical and microscopical aid have done much to elucidate the sources of disease and the right application of remedies. In another section, it will be shown that moist air favours the development of certain principles in the blood which engender cachectic ulcers, scrofulous conditions of the blood, and cutaneous affections; and hence we may, on scientific grounds, account for the beneficial influence of Malvern air as well as Malvern water in such morbid conditions. Independent of chemical and other influences on the functions, we may take into consideration mechanical influences in the diminution of pressure on the cutaneous surface of the circumambient air. Dr Sigismund Sutro remarks, that "the fact of Lowlanders affected with atonic ulcers of the skin being cured by a mere resort to the mountain air, without medical treatment, likewise indicates an improved cutaneous function."* In these conditions of improvement, however, other circumstances require consideration as elements in the cure—such as improved nutrition and consequent increased vital power. The author has witnessed numerous cases of cure in atonic ulcers and cutaneous affections during his residence in Malvern; but whether the cure has been attributable to the air, or water applications, or diet and improved nutrition, or, what is more probable, a combination of the whole, is a point which cannot always be determined. The cure, however, has been effected, and that is *the* satisfactory point to a suffering invalid.

The influence of a residence in Malvern on young people of strumous habits, with blood of low vital power, is remarkable. In a few weeks or months the change in the hue of the skin is often marvellous, and the increased muscular development is no less signal, indicating, as it does, more complete oxygenation of the blood, and more perfect nutrition of tissue. In many cases, where there has been little or no medical treatment, and no

* "On Spas and Climatic Resorts," p. 284.

essential change in diet, the beneficial influence must mainly be attributable to climate.

VIII.—Atmospheric Influences—Ozone.

The purity and hygienic influence of the Malvern atmosphere is unquestionable. On what does it depend? The explanation is not difficult. The purity of the Malvern water depends on the perfect infiltration of the rain which pours down its hill-sides through a stratum of gravelly soil, and which does not impart to it any mineral or organic principles. Malvern air is free from miasmatic influence in consequence of excellent drainage and the absence of decayed vegetable substances, such as are found in a morass or uncultivated district. Add to these influences, what is adverted to more at length in other sections, the genial influence of a full exposure to the sun's rays, and the partial return of the heat from a receptive soil; and also the equally genial influence of not severe but stimulating winds, and the tonic results of a residence in Malvern may be fairly estimated.

The question naturally arises, If the lower atmosphere is denser, and consequently fraught with a larger amount of oxygen, how is it that at the Malvern elevation such freedom of respiration is experienced, or that the whole frame feels exhilarated and energised on ascending the height above? The explanation is, that as we ascend the hill we breathe the more gaseous atmosphere of pure air, and leave below an atmosphere of comparative water and cold. Dry air contains a larger proportion of free oxygen; and not only is this the case, but dry air penetrates more freely the lungs—in other words, has a greater diffusive influence.

In estimating the purity of the air in any locality, reference must be made to the existence of ozone. Experimental observations prove the free existence of this essential vital element in the Malvern atmosphere. In what conditions of the air does it

most copiously exist? To what extent is its prevalence influenced by wind currents? Its marked absence in densely-crowded populations, and its free occurrence in rural districts, show that it is a natural ingredient of the air—in fact, its essential constituent. Ozone may be defined to be oxygen in a more concentrated form.* Vital statistics also agree with meteorological observations as to the connection of health or disease with the existence or absence of ozone in the atmosphere. In 1869, in the town of Salford, for example, it was found that, "generally, as the amount of ozone decreased, the seizures in measles, scarlatina, typhus, and continued fever increased." And it is patent that, in towns where there exists the least amount of ozone in the atmosphere, there exists the largest amount of disease, at least disease of that type which manifests a low condition of vital power. The presence of ozone by the sea-side, and in country districts, is no proof that it is more largely developed in certain districts, but that in crowded localities there exist conditions in the atmosphere which more rapidly consume it.

Ozone tests show that the existence of this vital agent in the Malvern air, as regards *amount*, ranks high. Representing the entire absence of ozone by 0, and 10 as maximum amount, the average quantity of ozone for the years ending 1868, 1869, and 1870, was 4·7.

Dividing the year into seasons, the result shows that—

Spring averages 5·0	*Autumn* averages 4·8
Summer ,, 4·7	*Winter* ,, 4·6

In 1869 the average of ozone through the months ranged from

* The following chemical theory is given as probable :—A molecule of oxygen contains two atoms, a molecule of ozone contains a third, or one atom additional. The formation of the latter body, in this sense, simply implies the condensation of oxygen into two-thirds of its former volume. As the formula of oxygen is O_2, the formula for ozone is O_3, and its oxidising power is due to the ease with which each molecule loses its third atom of oxygen.

5 to 7·5, the greatest amount occurring during the autumn and winter, the least during the spring and early summer months. Although the *average* is as above noted, yet the test-papers not unfrequently exhibit the maximum.

These data record not only a remarkable generation of ozone, but also an equally remarkable proof of its existence during the entire year. The tables of the Messrs Burrows, which extend over four years, record the presence of ozone throughout the entire twelve months in each year in abundant proportion, except when the wind was N.-E., E., or S.-E. The entire absence of this vital atmospheric constituent was noted only on fourteen days during a period of three years. A few cases of fever broke out amongst the boys of the college during a portion of the days when ozone was absent. The absence of ozone in Malvern during the prevalence of east winds, may partly be accounted for by the fact that east wind currents have to pass over a wide extent of plain, the ozone probably being exhausted before it reaches the town.

Seaside resorts not unfrequently register a higher proportion of ozone. This may arise from the fact that during a wind from the sea the maximum amount will be registered when the wind is from inland, while a trace will not be found. In reference to the existence of ozone in any special locality, the point for medical consideration is not the *amount*, which in some districts may be too large for a special class of invalids, but its existence *at all times*, and *in sufficient or abundant proportion*. It may be fairly presumed, and vital statistics corroborate the assumption, that the absence of ozone is an indication of the existence of conditions which cause its free or total absorption. These conditions are those which exist in crowded towns and badly-drained districts. Ozone may be characterised as Nature's deodoriser and disinfectant. A district like Malvern, where ozone is always found in abundant proportion, assuredly exhibits a remarkable absence of injurious influences.

IX.—Electric Conditions of the Atmosphere.

An element in the consideration of health, but one not commonly considered in its medical influence, exists in the electric condition of the atmosphere. An extract from Saussure, founded on practical observations, quoted by Dr Oliver in an ably-written article on "The Atmosphere of Towns in its Sanitary Aspect," shows that the intensity of the atmospheric electric potential "is much more considerable in elevated and isolated places than in narrow and confined situations : it is nearly absent in houses, in narrow courts, and alleys, and in enclosed places. In crowded cities, it is most intense in the squares and upon the bridges." Dr Oliver observes, "Who can tell how important a due change of electricity in the atmosphere may be to the correct performance of the function of respiration? Who knows the exact position, if any, which the animal tissues hold as conducting-media in the circulation between the positive electricity of the atmosphere and the negative electricity of the earth? and how far the health of the body may be affected by the removal of electricity from the atmosphere—the supposed circulation of electricity between the atmosphere and the earth, through the tissues of the body, being diminished or broken?" * The varying sensations of the body during changes of the weather; the tonic or depressive influences of winds and hygrometic transitions ; the influence of barometric changes on the functions—as, for example, digestion ; the action of the liver, heart, and lungs; these, probably to a large extent, depend on occult electric conditions between the body, which may be viewed as an electric apparatus, and the electric atmosphere in which it moves.

These observations, in conjunction with those which have preceded on the existence of ozone, lead to the consideration that

* *British Medical Journal*, 1870, p. 359.

electricity and ozone are words practically expressive of the same thing—or, at all events, that the formation of ozone is dependent on electric influences. Two points require prominent consideration—the first, those causes which generate ozone—these are probably electrical; and secondly, the conditions which favour its rapid absorption. The free generation of ozone is a law of nature, influenced, it may be, by varying circumstances, such as temperature, wind currents, moisture, vegetable growths, &c., but its absorption as a health agent will depend on circumstances equally varied, such as crowded populations, malarious effluvia, and pent-up districts or habitations.

X.—Aspect in Relation to Light and Solar Influences.

Aspect constitutes an important hygienic element in the selection of climate, and this not merely in reference to invalids, but to individuals in moderate health, in whom there may exist a pre-disposition to disease. The different winds, as elsewhere noted, bring with them a difference in dryness or humidity, and therefore a difference in physiological influence and animal feeling. Thus position in regard to wind currents is of considerable importance. Aspect holds an equally important relationship in regard to *warmth* and *light*, influences which proceed from the same source.

The solar beam gives forth three forces—light, heat, and actinism, the latter force representing the chemical action of the sun's rays. On each of these solar influences, it will be necessary to dilate in any estimate of climatic residence.

Heat constitutes a hygienic agency, which is closely connected with aspect. A full exposure to the sun's rays forms a source of health which can only be estimated by a comparison of facts. Heat is, in a large sense, essential to vitality. The growth of plants and animals is influenced by temperature. Plants,

through the instrumentality of chemical action, form store-houses for the solar rays, and as heat-conservators restore it again to man and other animals for the higher purposes of organisation.

The influence of *light* as a hygienic agent is an element of essential consideration in an estimate of the value of Malvern as a residence. The geographical aspect of Great Malvern, as already described, is south-east, and its exposure to the influence of the sun and light is uninterrupted. How light influences the growth and colour of flowers is well known. Flowers which receive free exposure to light not only proportionately increase in growth, but display a deepness of tint which is absent when placed under a shade. A plant kept in total darkness will produce perfectly white flowers ; but when exposed to the influence of light, it will exhibit the brilliant and variegated hues of nature. So it is with animal life. The want of exposure to light has a material influence in retarding animal growth. Tadpoles, when excluded from light, continue to grow, but do not become frogs. In those natives tribes where the person is chiefly out of doors, and exposed to exercise, air, and light, there is observed to be an absence of deformity and other conditions of animal weakness. The opposite condition is found in persons working in badly-ventilated and badly-lighted manufactories or shops, and also in those individuals who reside in narrow streets and back passages, where the light or warmth of the sun rarely or insufficiently penetrates. Light increases the tension and solidity of the muscular fibres, and consequently acts as a stimulant and tonic. The absence of light relaxes and enfeebles the skin, and renders it susceptible of antagonistic influences. Even in tropical climates, men exposed to the action of light are active and vigorous, while persons chiefly residing in confined apartments are indolent and unable to endure fatigue.

A few confirmative illustrations may tend to illustrate these views. Jesse, the well-known naturalist, relates an interesting

fact in relation to light and vegetable life. A potato was accidentally left in a cellar, in a corner opposite to a small chink, which admitted the light. It shot out a runner, which determinedly extended itself along the floor not less than twenty feet, crept up the wall itself, and literally grew through the aperture. The same may be said of animal life. It has been noticed by medical writers, that on the dark side of a sick-ward the mortality is greater than the one which is exposed to the influence of light. Sir David Brewster informs us, that in great cities, during the prevalence of cholera, "it was invariably found that the deaths were more numerous in narrow streets and northern exposures, where the salutary beams of light and actinism had seldom shed their beneficial influence." Miss Nightingale, in her "Notes on Hospitals," in some practical remarks on this subject, informs us that, even when it gives them pain, nearly all the patients lie with their faces turned to the light. "Then why *do* you lie on that side? The patient does not know; but we do. It is because it is the side towards the window." Dr Edward Smith observes, "Sunlight is undoubtedly powerful in sustaining vital action, and in some of our experiments we proved that it increases the morning pulsation ten or twelve beats per minute." *

These and other equally corroborative facts seem to realise the truth of the Italian proverb, "Where light is not permitted to enter, the physician will have to go." Another source of atmospheric purity in Malvern may arise from the fact that in a more elevated region the atmosphere is less dense, and the light consequently is more intense, than in the plains below. In a less dense medium, the light is reflected in larger proportion than it is absorbed. Hence the value of exposure to the sun's rays in an elevated position.

Facts so conclusive in reference to the hygienic influence of

* "Cyclical Changes, Health and Disease," &c., 1861, p. 99.

the sun's rays have led modern physicians to recommend an excellent method adopted by the ancients to invigorate the body—its exposure to an air bath, termed *solaria*, *i.e.*, free exposure to sunlight, with a very limited amount of clothing. Dr Forbes Winslow advocates the practice in growing children. Dr Wynter suggests the erection of glass-house nurseries on the tops of houses, where scrofulous children can be exposed to the influence of air and light. The convalescents at the Hospital of St John, at Brussels, derive great improvement from a garden *solarium* built on its roof, and to which they have free access. The Malvern Hill may be viewed as a great natural solarium of moderate elevation, with full exposure to the south-east, having a long period of sun influence, and thorough ventilation by genial winds. Hence, doubtless, one cause of its remarkable historical celebrity in strumous cases.

It seems not improbable that solar influence hygienically affects the atmosphere in other ways. Iron constitutes an essential constituent of the blood. "It is quite certain," remarks Liebig, "that if iron be excluded from the blood, life cannot be supported." In strumous and other analogous conditions, there is manifest absence of iron in the vital fluid. The red corpuscles are largely deficient, and in particular in those persons who are fed with food devoid of iron, and who are not exposed to light. In such cases, a visit to a watering-place, where the air is pure, with a supply of good nutritious food, and the drinking of water from an iron spring, rapid improvement takes place. Does not nature supply an air spring containing iron equally efficacious in its effects? Various facts lead to the conclusion that the sun sends forth iron from its life-giving fountain, which permeates our atmosphere, and undergoes absorption by the lungs and skin. Under this impression, it has been eloquently remarked, "The bright tinge acquired by the blood under a tropical sun, would seem to indicate that iron is taken into the human system by the lungs and the skin. A sun bath is, therefore, an iron bath; and

the brightness of the insects and of the gorgeous flowers of the tropics is only, it would seem, an effect of this great colouring agent. Man is made beautiful by that which makes the earth beautiful. The red river that rushes rich with life through artery and vein is tinged with the same force that dyes the purple of the plants, specks the rich porphyries, flushes the rosy granite of Egypt, and pencils the changing blue of Welsh and Highland hills. The rich colour and cosy warmth of an English town, set in a fringe of green, are due to the same agent which burns in brick and tile." *

One cause of mischief from the prevalence of smoke in towns probably arises from its mechanical influence in obstructing the transmission of the sun's rays. The actinic or chemical rays are well known to be copiously absorbed by smoke. The same, also, may be said in reference to the caloric and luminous rays. These facts are familiar to photographic artists, who are not unfrequently compelled to remove their studios from a smoky atmosphere to the purer air of a suburban district.

The absorption of the actinic rays in towns or other smoky districts, doubtless exercises an influence, not merely on the animal functions, but on animal colour. Plant life and animal life are in many respects wrought upon by similar causes. The colour of flowers and of human beings soon undergoes change by exposure to the influence of the rays of the sun. Gardeners, for example, are aware how largely they can modify colour by screening certain plants from the direct solar influence. The actinic power is most potent in spring. At this season the sun's rays appear to exercise an active effect on the chlorophyll, or chromogen, or colouring matter of plants, whose leaves progressively deepen in their tints. In autumn, also, the heat-giving rays are most active, and by their action on the chlorophyll, give rise to the deepening colours of fruits and foliage. Autumnal tints are understood to originate in solar radiant influence, and the loss of carbon. Animal colour also largely depends on

* "Meliora," July 1867, p. 137.

warmth, light, and actinic force. The latter agent is supposed to be a principal cause of embrowning the skin, but on this point we require confirmatory evidence. The influence of the sun on the skin, and on its pigment, is a matter of universal observation, whether on the Negro, the Asiatic, or the European, or in mild regions during different portions of the year, and in relation to exposure. How different the sunburnt face of the outdoor labourer from the pale, lifeless hue of one whose hours are spent in buildings or workshops, where the light scarcely penetrates. The black pigment of the negro becomes paler in less torrid climes, indicating a direct relationship between climate and the colour of the skin.

In a work entering into the value of climate, we must not omit some notice of those abnormal elements which exist in the atmosphere of towns or crowded localities, and in other places where hygienic precautions are neglected.

The effects of bad drainage, of stagnant water, of decayed vegetable or animal masses, and other similar sources of malaria, have been adverted to in other sections. They constitute prolific sources of disease in any district, crowded or otherwise. There are, however, certain conditions essentially health-antagonistic to which towns are subject. Among these, one has already been mentioned, *smoke*, which, apart from any direct influence on the body, is a source of mischief by its absorption of, and consequent interruption of, the sun's rays. Another source of evil, more or less injurious to all, but mischievous to a large degree in workshops, alleys, confined streets, where the dispersing influence of wind rarely extends its benevolent sphere of operation, arises from the elimination of carbon from the human lungs, a substance fatal to animal life, however nutrient to vegetables. It is estimated that the amount of this poisonous gas thrown off from the lungs and skin of one human being is, at a low estimate, twenty ounces in the twenty-four hours, and the aggregate amount, in a population like that of Manchester, about 400,000, would be not less than 260 tons per day. The value, therefore, of

ventilation, not merely in houses, but on that large scale which Nature has wisely ordained in atmospheric storms, may be readily conceived. Not merely do the winds benevolently scatter in all directions a gaseous product, which, confined within the precincts of human habitations, acts destructively to animal life, but the very thunder and lightning, which occasion terror to many, liberate from heaven's laboratory elements which load the air we breathe with life-giving and health-inspiring atoms.

XI.—Disease Emanations, &c.

Disease emanations from animals may also be considered as sources of mischief in large towns, or in any locality. Reference is made to those morbid emanations from the victims of disease, whether from the lungs, the skin, or any other of the excretory organs. Recent microscopical revelations show us that this source of disease is one of not trifling estimate. City or town air, it is now demonstrated, contains particles of mucus, with fragments of epithelial scales. The air of crowded assemblies has been found to contain the same animal morbid products. Horses and cows throw off mucus in larger proportion in the streets and in cattle exhibitions. Dr Sigerson, of Dublin, observes that "granules of a like kind were found in the atmosphere of a patient seized with infantile remittent fever of a severe type, and the observer believed that the irritation of the membranes of his own eyes and nose that ensued was due to their presence. I consider that they, in all probability, are the agents in contagion, acting possibly by altering the molecular condition of the fluid with which they come in contact, which alteration is propagated, more or less efficiently, through the system." We are, in our present state of knowledge, unable, with any degree of accuracy, to estimate the aggregate influence of morbid exhalations in cases of fever, eruptive disorders, and other complaints which engender products unquestionably putrescent in their nature, and fertile in their generation of disease.*

* In a paper read before the Philosophical Society of Manchester, by J. B. Dancer, F.R.A.S., entitled "Microscopical Examination of the Solid

XII.—Miasmatic Influences.

Is there any reason to suppose, if any miasmatic influences should arise from below, that they are conveyed by winds or other atmospheric agencies to the heights above?

Marsh air is heavier than common or pure air, and therefore, without some controlling influence, is unable to rise beyond the place of its generation. Even in a house influenced by malarious exhalations, persons living in upper apartments suffer less than those who occupy the ground-floor.

The causes of malaria are various. Decomposed vegetable or animal substances, stagnant pools, marsh exhalations, bad drainage; these, and a variety of other causes, unquestionably give rise to poisonous gases, and consequently to atmospheric deterioration.

Certain conditions favour its development or escape, or keep it in abeyance. Moisture, for example, facilitates its elimination. Foliage seems to have a strong attractive influence, and hence miasma is more potent in the vicinity of trees. Water destroys it. Good fires do much to banish it. The sun's heat on stagnant surface water strongly favours it.

With reference to Malvern and the valley beneath, it is only necessary to state that land cultivation has done much to remove the sources of malaria, and that although something yet remains to be accomplished in the way of more effectual cottage drainage, and the clearance of stagnant ditches, yet these are too limited in their nature, and too distant in their situation, to permit, even by occasional favourable wind currents, the convey-

Particles from the Air of Manchester," the writer states—"For the purpose of obtaining a rough approximation of the number of spores, or germs of organic matter, contained in the fluid received from Dr Smith, I measured a quantity by the pipette, and found it contained 150 drops of the size used in each examination. Now, I have previously stated that in each drop there were about 250,000 of these spores, and as there were 150 drops, the sum total reaches the startling number of 37½ millions, and these, exclusive of other substances, were collected from 2495 litres of the air of this city—a quantity which would be respired in about ten hours by a man of ordinary size, when actively employed."

ance of any appreciable noxious elements to the heights above. The mischief, so far as it exists, is purely local in its influence.

Much may be done in the way of prevention as respects malarious influences. At all times especial care should be taken to avoid deposits of decomposed animal or vegetable substances, which may serve as sources of mischief, to be developed only in wet seasons, when the rain loosens the mass, and disengages and impregnates the atmosphere with noxious gases. It is in this way, unquestionably, that many springs of comparatively pure water become sources of disease after heavy falls of rain. It is well known, also, that the influence of the sun's heat on marshy ground is a prolific cause of malaria. In all places, but in particular in health resorts, the decomposition of leaves and other vegetable substances should be prevented. The most effectual means to attain this object is by fire. When shrubs are cut, they should, as quickly as possible, be burnt, and the ashes utilised.

XIII.—General Summary.

The advantages of Malvern climate may now be briefly summarised :—

1. *Height*, which, although moderate, induces a condition of the atmosphere favourable to a large class of invalids.

2. *Position*, being exposed so as to receive freely the rays of the sun, and, in particular, the morning sun. The caloric is absorbed by a soil which again slowly restores it to the atmosphere. This effects an equable distribution of temperature during the twenty-four hours, night as well as day.

3. Its *sheltered position from the coldest winds*, being chiefly situated on a portion of the hill which is protected largely from the north, almost altogether from the west, the easterly winds being limited in their prevalence, and, as experience shows, blowing over the building sites against the hills, and scarcely at all, or in small degree, influencing the vegetation.

4. The *dryness of the soil*, the greater portion of the town

being built on a gravelly substratum, formed of the detritus or broken-down rock, and which is highly favourable to water infiltration, and by its elevation and slope to effective sewerage.

5. The *dryness of the atmosphere*, which is attributable to several of the conditions mentioned under the previous heads, *i.e.*, height, position, shelter, winds, and soil.

6. A peculiarly favourable aspect in relation to *light and other solar influences.*

7. The purity of its atmosphere, and free presence of ozone.

The other conditions favourable to hygienic results are—

a. *Its thorough system of drainage.*

b. *The absence of all malarious influences.*

c. *Its pure water.*

d. *Its superior dwellings.*

XIV.—Vital Statistics.

The subject of this section is of deep interest. I have devoted some considerable time to its elucidation, and have endeavoured to arrive at as accurate results as possible. They are, as will be seen, in remarkable harmony with the meteorological and other statements made in previous sections, and exhibit close correspondence between the death-rates and hygienic conditions of the district. Very strong claims have been made in reference to the climate of Malvern as a health-resort, on the ground of position, soil, atmospheric, and other influences. The question now arises, how far the returns of mortality correspond with the geographical and other conditions, and whether vital statistics present evidence equally demonstrative of its climatic advantages?

The census for 1871 gives the following essential preliminary analysis :—

	Area in acres.	Inhabited houses.	Uninhabited houses.	Population.		Total 1871.	Total 1861.
				Males.	Females.		
Great Malvern.....	5021	1253	26	3138	4468	7606	6054

The following tables constitute important preliminary analyses. They have been made with extreme care by the author from the books of the District Registrar. Each case is certified by the medical attendant. Those included in the years 1864–6 are due to the labours of Dr Johnson, and were published in 1867 :—

TOTAL DEATHS IN THE YEARS 1864–70.

	Resident.	Visitors.	Total.
1864.....	104	24	128
1865.....	73	17	90
1866.....	35	35	70
1867.....	82	22	104
1868.....	74	20	94
1869.....	92	29	121
1870.....	82	22	104

TABULAR LIST OF THE CAUSES OF DEATH IN THE PARISH OF MALVERN DURING THE YEARS 1864–70.

DISEASES.	1864.	1865.	1866.	1867.	1868.	1869.	1870.	RESIDENTS & VISITORS. Total deaths in 7 years.	Death-rate per year per 1000.
A. Zymotic diseases.....	31	16	10	4	8	24	8	101	2·0
B. Diseases of the air passages	27	16	17	22	20	25	19	146	2·9
C. Diseases of the heart.....	6	10	7	9	7	16	15	70	1·4
D. Diseases of the nervous centres.....	19	17	15	29	20	20	15	135	2·7
E. Abdominal and allied diseases.....	21	11	10	21	18	12	25	118	2·4
F. Miscellaneous diseases.....	22	17	9	17	21	21	18	125	2·5
G. Accidents.....	2	3	2	2	0	3	4	16	·3
Deaths of residents and visitors each year.....	128	90	70	104	94	121	104	711	14·5
Deaths of visitors only.....	24*	17	35	22	20	29	22	169	
Deaths of residents only	104	73	35	82	74	92	82	542	†12·9

* Visitors this year not taken—an assumed estimate average is given.

† An average of nearly 1·3 per cent. of the population.

Taking the average estimate of 7000 for the whole population —*residents and visitors*—during the seven years from 1864 to 1870 inclusive, and 6000 for residents only during the same period. The population of Malvern in 1861 was 6054.

TABULAR LIST OF CAUSES OF DEATH IN THE PARISH OF MALVERN DURING THE YEARS 1867–8–9–70.

DISEASES.	1867.	1868.	1869.	1870.	Total Residents and Visitors.	Visitors.	Death-rate per year per 1000, Residents and Visitors.	Death-rate per year per 1000, Residents only.*
A. Zymotic diseases	4	8	24	8	44	8	$1\frac{3}{8} = 1{\cdot}4$	$1\frac{2}{7} = 1\,2$
B. Diseases of the air passages...	22	20	25	19	86	15	$2\frac{11}{16} = 2{\cdot}6$	$2\frac{15}{28} = 2{\cdot}5$
C. Diseases of the heart.....	9	7	16	15	47	15	$1\frac{15}{32} = 1{\cdot}4$	$1\frac{1}{7} = 1{\cdot}1$
D. Diseases of the nervous centres.....	29	20	20	15	84	16	$2\frac{5}{8} = 2{\cdot}6$	$2\frac{3}{7} = 2{\cdot}4$
E. Abdominal and allied diseases	21	18	12	25	76	27	$2\frac{3}{8} = 2{\cdot}4$	$1\frac{3}{4} = 1{\cdot}7$
F. Miscellaneous diseases.....	17	21	21	18	77	9	$2\frac{13}{32} = 2{\cdot}4$	$2\frac{3}{7} = 2{\cdot}4$
G. Accidents.....	2	0	3	4	9	2	$\frac{9}{32} = {\cdot}2$	$\frac{1}{4} = {\cdot}2$
	104	94	121	104	423	92	$13\frac{7}{32} = 13{\cdot}2$	$11\frac{23}{28} = 11{\cdot}8$

Calculated on the assumption of 8000 residents and visitors all year round, and 7000 resident population.

The above estimate has been made on very careful calculation as to residents and visitors. The population of Malvern in 1861 was 6054. The establishment of the college and several important schools has taken place within the last few years, adding to the population of pupils alone not less than 600.

The above table exhibits a remarkable decrease in the death-rate in the last four years (1867–70) compared with the average of the years 1867–69. This, doubtless, is attributable to the improved sanitary arrangements of the town.

With a view to more accurate and minute analysis, the heads

* It will be readily seen that the calculations would agree if the decimals were carried out.

classified above are now given with the distinctive diseases underneath, as extracted from the Parish Registrar's book. This analysis is important, if not essential, to attaining any fair conclusion of the existence or non-prevalence of certain forms of disease in any locality:—

A.—Zymotic Diseases.

	1867.	1868.	1869.	1870.	Total in 4 years.
Diphtheria	0	1	2	4	7
Croup	...	...	...	1	1
Erysipelas	1	...	...	...	1
Fever	2	...	1	...	3
Hooping-cough	...	...	2	...	2
Measles	...	...	3	1	4
Scarlet fever	...	1	13	2	16
Typhus	...	1	3	...	4
Typhoid fever	1	5	...	...	6
Smallpox	...	...	...	...	...
	4	8	24	8	44

Total cases of zymotic diseases in four years, 44—visitors 8; leaving 36, or 1·28 in each 1000 of the resident population.

The majority of these cases are attributable to removable causes. Of diphtheria, an average of only two cases occurs in each year; of the four cases which occurred in 1870 all were adults, and three of them were visitors. Not a single instance of death by small-pox occurs in four years. Of fever, nearly all the cases are of persons residing in inferior dwellings. The cases of death from scarlatina, under *ordinary* circumstances, average 1 per year of the *whole* population of 8000. The exception was in 1869, which was the year of scarlet fever throughout the kingdom, when several of the large schools were compelled to break up their course of study. Of the thirteen cases of scarlatina which occurred in this year in Malvern, ten were those of children under five years of age.

Since penning the above notes, the Quarterly Return of the Registrar-General has been issued for the months April, May, and June 1871, when it is shown that "Worthing, Sidmouth, Llandudno, *Malvern*, Lowestoft, and Margate were most conspicuous for their freedom from deaths of a zymotic character," Malvern being the lowest on the list.

B.—Diseases of the Air Passages.

	1867.	1868.	1869.	1870.
Asthma	...	1	2	1
Bronchitis, simple or complicated	4	2	3	4
Congestion of lungs	4	...	3	2
Inflammation of lungs	3	7	5	4
Pulmonary disease (?)	1	1	3	2
Pulmonary consumption	7	9	8	6
Tumour on the trachea	1	...	...	...
Hydrothorax	2	...	...	...
Laryngismus	...	...	1	...
	22	20	25	19

Total of cases of diseases of the air passages or respiratory organs in four years, 86—visitors 15; leaving 71, or 2·53 in each 1000 of the resident population.

These data in reference to diseases of the air passages are eminently conclusive. The death returns in England and Wales, according to the report of the Registrar-General, published about 1840, made the number of cases of phthisis alone as 19·55 per cent. of the total number of deaths, or 3·82 annually out of 1000 living persons. More recent statistics exhibit an equal mortality from the same cause—*i.e.*, at the rate of four persons in every thousand of all ages, and eight in every thousand adults.*

* "The following figures—the result of calculations founded on the last report of the Registrar-General—certainly rather understate than exaggerate the magnitude of the evil:—Of the 65,000 deaths which occur every year in England and Wales from slow and lingering diseases, about 39,000 are probably due to pulmonary consumption. One-ninth of the total mortality of all ages, and more than one-fifth of the mortality of

Compare this statement with the returns of Malvern.

The total number of deaths in four years (1867–70), including the whole of the maladies ranked under the head of diseases of the respiratory organs, as tabulated above, was 86, or only 2·6 in every 1000 living persons. This was one-third less than the mortality that occurred throughout the United Kingdom from phthisis alone.

The total number of deaths from phthisis during four years in Malvern was 30,—*i.e.*, rather under eight cases in each year; or, estimating the population and visitors in Malvern so low as 8000 throughout the year, *under* one death for each 1000 living persons. Under any view it can scarcely be said that the Malvern climate predisposes to disorders of the organs of respiration. On the contrary, it would appear that the immunity from this class of affections is decisive and remarkable.

C.—Diseases of the Heart.

	1867.	1868.	1869.	1870.
Heart disease	5	3	7	8
Heart and dropsy	1	4	5	4
Valvular disease	...	...	...	1
Heart spasm	1	...	...	...
Heart aneurism	1	...	...	...
Heart dilatation	...	...	1	...
Dropsy of pericardium	1	...	...	...
Cardiac hypertrophy	...	...	1	1
Fatty degeneration	...	...	2	1
	9	7	16	15

Total number of cases of diseases of the heart in four years, 47—visitors 15; leaving 32, or a little over 1 in each 1000 of the resident population.

adults, is due to this cause; and as the duration of the disease, taking one case with another, is about two years, it follows that about 78,000 persons are constantly suffering from consumption; being at the rate of four persons in every thousand of all ages, and eight in every thousand adults." —*Annual Report of Consumption Hospital, Brompton,* 1870-1.

Let us compare this result with the average rate of mortality from the same class of disease in the general population, and this because the idea prevails that the climate and topographical conditions of Malvern favour the generation of heart disease. Dr Haviland, in his lectures on "The Geographical Distribution of Diseases in England and Wales," adduces some important statistical facts and conclusions based on the Registrar-General's annual report. The deaths from heart disease and dropsy in the decenniad 1851–61, "amounted to more than one-seventeenth of the whole mortality." "Compared with the death-rate from other causes, that from heart disease and dropsy holds a high place in the order of mortality."* It appears that although phthisis claims every year double the number of victims that die from heart disease and dropsy, yet the deaths from the latter causes were equal in number to those who succumbed to cholera, diarrhœa, and dysentery. The deaths, strange to say, from small-pox and scarlet fever fell short of those from heart disease and dropsy by 28,470. The mean annual mortality of the entire series of the twenty-seven coast counties for heart disease and dropsy is 11·9 to every 10,000 living persons; of the twenty inland counties—*i.e.*, those which are situated between the coastal and midland counties—12·5 to every 10,000 living persons; while the mean annual mortality of the six midland or central counties is 15·1 to every 10,000.

It will be seen, from the statistical table above, that including heart disease of every kind and its complications amongst residents or the native population only, the mortality in this class of disorders is lower than even in the twenty-seven coast counties, where the deaths from heart disease and dropsy are the lowest. Or, in other words, in every 10,000 of the population of the six midland counties, the average deaths amount to 15·1, while in Malvern the average deaths in 10,000 reach only 11·4.

Dr Haviland remarks that the same general law obtains

* *British Medical Journal*, p. 453.

throughout the three divisions of England and Wales into registration divisions, counties, and districts—viz., that wherever the prevailing sea-winds have uninterrupted access, as over a flat or elevated country, or up broad vales or valleys, there we find a low mortality from heart disease; and that, on the contrary, in places where the tidal wave has no access, where the rivers run at right angles to its course, or to that of the prevailing winds, there we find the highest mortality from this cause of death.*

D.—Diseases of the Nervous Centres.

	1867.	1868.	1869.	1870.
Congestion of the brain	...	2	1	...
Paralysis	3	8	6	3
Convulsions	11	5	3	5
Encephalitis	1	...	...	...
Inflammation of the brain	2	1	...	...
Apoplexy	7	3	3	1
Epilepsy	1	...	...	...
Delirium Tremens	1	...	...	1
Meningitis	1	...	3	...
Teething	1	...	...	1
Cerebral excitement	1	...	...	...
Softening of the brain	...	...	...	1
Hydrocephalus	...	...	1	...
Brain effusion	...	1	3	3
	29	20	20	15

Total number of diseases of the nervous centres in four years, 84—visitors 16; leaving 68, or 2·4 in each 1000 of the resident population.

In nearly all the cases under the head "convulsions," the deaths are children not exceeding five years. Most of them are mere infants, and in every instance the children of journeymen labourers, or persons living in the worst localities or out-districts, and ignorant as regards physical education.

* *British Medical Journal*, 1870, p. 454.

The cases of paralysis in the years 1867–70 amount to 20. The respective ages were :—

From 30 to 40	1	cases.
,, 40 to 50	2	,,
,, 50 to 60	3	,,
,, 60 to 70	4	,,
,, 70 to 80	5	,,
,, 80 to 90	5	,,
	20	

The deaths during the same years from apoplexy were 14. The ages of the parties were as follows :—

From 30 to 40	2	cases.
,, 40 to 50	2	,,
,, 50 to 60	1	,,
,, 60 to 70	3	,,
,, 70 to 80	5	,,
,, 80 to 90	1	,,
	14	

E.—Abdominal and Allied Diseases.

	1867.	1868.	1869.	1870.
Mesenteric disease	...	...	...	2
Marasmus	1	...	...	...
Intus-susception	...	...	2	...
Ulceration of the stomach	1	...	1	...
Diseased stomach and œsophagus	...	...	...	1
Tubercular disease of the stomach	1	1	1	1
Diseased liver	4	1	...	1
Diarrhœa	1	6	...	8
Inflammation of the abdomen	1	...	...	...
Disease of the kidney	2	3	...	2
Granular degeneration of the kidneys	1	...	...	...
Chronic irritation of abdominal viscera	1	1	1	...
Imperforate intestine	1	...	...	...
Perforate intestine	...	...	1	...
Ulceration of the bowels	...	...	1	...
Cancer of œsophagus	1	...	...	...
Cancer of rectum	...	...	...	1
Peritonitis	1	...	1	2
Pelvic cellulitis	...	...	1	...
Morbus Brightii	1	...	1	...
Diabetes	1	1	...	1
Albuminaria and liver disease	...	...	...	2
Abdominal tumour	1	...	...	1
Jaundice	1	...	1	...
Dysentery	1	1	...	...
Urenœmia	...	1	...	...
Abscess of liver	...	...	...	...
Bilious fever	...	...	1	...
Chronic disorder of the bladder	...	...	...	1
Dropsy	1	3	...	2
	21	18	12	25

Total of abdominal and allied diseases in four years, 76—visitors 27; leaving 49, or 1·75 in each 1000 of the resident population.

The figures under the above head include a range of disease common to all districts, and not one appears to be in excess. The cases of diarrhœa occur amongst the children of the labouring classes. The seven cases registered in 1870 are all under the age of twelve months, several of them being only a few weeks old. This remark has equal reference to those registered under the same head for 1868. The children were born to die of neglect or ignorance.

F.—Miscellaneous Diseases.

	1867.	1868.	1869.	1870.
Old age	3	2	9	4
Abscess of hip	1	...	...	...
Inanition	1	8	...	...
Atrophy and low vitality	7	2	2	4
Malignant tumour	1	...	...	...
Tumour	...	1	...	...
Hæmorrhage	1	1	1	1
Carcinoma of breast	1	1	1	...
Parturition-peritonitis	...	...	1	...
Gout	1	...	...	2
Gangrena scrotum	...	1	...	...
Cancer of the glands of neck	...	1	...	...
Chlorosis	...	1	...	...
Lumbar abscess	...	2	1	...
Disease of the spine	...	1	1	...
Spinal injury and paralysis	..	...	2	...
Rheumatism	...	...	...	2
Inflammation of hand and arm	...	...	1	...
Syphilis, congenital	...	...	...	1
Premature birth	1	...	2	3
Indeterminable	...	...	...	1
	17	21	21	18

Total of miscellaneous diseases in four years, 77—visitors 9; leaving 68, or 2·4 in each 1000 of the resident population.

A few of the above diseases might with propriety have been placed under other divisions, but are retained under this head

for the sake of convenience. Those recorded under the heads "atrophy" and "inanition" are children, and in nearly every case mere infants.

The following is a summary of three classes of prevailing causes of infantile mortality previously tabulated :—

	1867.	1868.	1869.	1870.
Convulsions	11	5	3	5
Diarrhœa	1	6	...	8
Atrophy	7	2	2	4
Inanition	1	8	...	...
	20	21	5	17

The following table of age and cause for the year 1867 is given to exhibit the large mortality amongst children, most of them mere infants, whose deaths, probably, were in nearly every case attributable to ignorance, want of proper nursing, undue exposure, or other preventible causes. It will be seen, on reference to the tables adduced elsewhere, that out of 104 deaths in 1867 (inclusive of 22 visitors), the mortality of infants under twelve months was 27, and of persons 60 years of age and upwards, 29.

INFANT MORTALITY AND CAUSES, 1867.

CAUSE OF DEATH.	AGE.	MONTH.	PARENT'S OCCUPATION.
Marasmus from birth...	5 months.	January....	Journeyman painter
Congestion of brain —Convulsions	4 months.	„	Workman.
Congestion of brain —Convulsions	4 months.	„	Gardener.
Convulsions.....	7 weeks...	„	Workman
Convulsions.....	4 days.....	„	Pensioner
Inanition.....	17 days.....	February...	Farm labourer
Convulsions—Atrophy.	2 months.	„	Journeyman tailor
Congestion of brain —Convulsions.....	10 months.	March.....	Farm labourer
Premature death— Atrophy.....	2 months.	„	Servant
Low vitality.....	2 months.	„	Watchmaker
Atrophy.....	9 weeks...	„	Watchmaker
Congestion of lungs....	5 weeks...	April.....	Plasterer
Convulsions.....	32 hours...	„	Journeyman bricklayer
Convulsions.....	6 months.	„	Hairdresser
Inflammation of lungs.	3 months.	May.....	Journeyman blacksmith
Imperforate intestine...	6 days.....	„	Journeyman carpenter
Congestion of lungs....	16 months.	„	Journeyman bootmaker
Infantile bronchitis.....	2 months.	„	Quarryman
Infantile bronchitis.....	2 months.	„	Journeyman gardener
Convulsions.....	7 weeks...	June.....	Flyman
Atrophy.....	6 weeks...	August.....	Farm labourer
Pneumonia.....	10 months.	September	Stonemason
Teething.....	6 months.	„	Army captain
Convulsions.....	2½ days.....	„	Clerk in orders
Atrophy.....	1 year.....	October....	Farm labourer
Peritonitis.....	5 weeks...	November.	Publican
Congestion of lungs....	3 weeks...	„	Wheelwright
Atrophy.....	19 days.....	„	Wheelwright
Atrophy.....	4 months.	„	Labourer
In all, 27 cases.	All except two of these under twelve months.	The deaths chiefly in the more severe months.	Except two of these cases, all in humble circumstances.

The deaths in the year 1867 of the resident native population may be thus summarised :—

Deaths of children under 1 year	27	
Deaths of persons from 60 to 90	29	
Deaths of persons from 1 year to 59	48	
		104
Deduct deaths of visitors		22
Total deaths of residents		82

G.—ACCIDENTS.

	1867.	1868.	1869.	1870.
Fall—brain effusion	2	...	...	...
Injuries from a fall	...	...	...	3
Drowning	...	...	2	...
Found dead	...	...	1	1
	2	0	3	4

Total, 9—visitors, 2; residents, 7.

MORTALITY IN THE RESPECTIVE MONTHS OF THE YEARS 1867–8–9–70.

	1867.	1868.	1869.	1870.	Total in 4 years.
January	10	15	7	4	36
February	8	9	14	11	42
March	12	8	7	9	36
April	10	8	12	9	39
May	10	4	13	11	38
June	9	3	8	7	27
July	5	10	15	9	39
August	7	10	12	9	38
September	8	5	8	9	30
October	6	9	6	14	35
November	12	10	11	5	38
December	7	3	8	7	25
	104	94	121	104	423

The difference in the months of January, February, March, April, May, July, August, October, and November is not considerable, the mortality in February being the highest, although in two of the years it is low. The least mortality occurred in December and June. The tables exhibit so nearly the same

ratio through the twelve months, as to show the equableness of the climate, and the absence of any special adverse influence. The winter and spring months, as shown in the meteorological tables, are not severe, and the comparatively small rate of mortality corresponds. In February 1867 and 1868, the deaths were only 8 and 9 in each of the years. In 1869 they reached to 14, but of these, 5 were of the respective ages of 75, 73, 72, 80, and 93; while in 1870, out of 11 cases, 2 were infants, and 6 of the others were of the respective ages of 67, 69, 69, 73, and 77.

In March 1867 there were 12 deaths. Of these, 1 was aged 81; of 6 others, 2 were five years old, 1 ten months, 1 nine weeks, 2 two months.

In November 1867 there were also 12 deaths. Of these, 4 were of the respective ages of 78, 79, 80, and 80. 4 others were infants aged four months, five weeks, three weeks, and nineteen days.

In 1868 the deaths in January were 15. Of these, 2 averaged 74 and 89. Six others were of the ages of five years, three years, five months, three months, fourteen weeks, and nine days.

In 1869 the deaths in February were 14. Of these, 7 out of the 14 were upwards of 70 years of age, their respective ages being 72, 73, 75, 77, 80, and 93, while one was an infant of ten months.

In April 1869 the deaths were 12. Of these, 2 were premature births, 1 two months, 1 nine months, 1 twelve months, while 2 were 76 and 88.

In May 1869 there were 13 deaths. Of these, 3 were aged 74, 80, and 83. 6 were under three years,—*i.e.*, four months, ten months, fourteen months, nineteen months, two years, and three years.

In July 1869 there were 15 deaths. Of these, 4 were aged 74, 78, 80, and 82; while 4 others were—2 four years, 1 three years, and 1 five months.

In August 1869 the deaths were 12. Of these 1 was aged

84, 5 were aged four years, 2 two years, 1 nine months, and 1 four months.

In October 1870 the deaths were 14. Of these, 1 was 78, of 4 others 1 was two years, 1 twelve months, 1 eight months, and 1 six days.

In the year 1869 it will be observed that the deaths, which were in excess over the average, amounted to 121. Of this number the mortality amongst visitors was 29. Of these 29 visitors 10 deaths were those of persons over 70 years, and 8 deaths of persons over 50 years. The causes of death in these cases were paralysis, cardiac and other affections incidental to advanced life.

The mortality amongst children in this year under five years was 37. These were children of agricultural labourers, gardeners, stonemasons, grooms, carpenters, bricklayers, and servants—persons living in out-districts and in inferior dwellings, totally ignorant and unobservant of the laws of health.

The reduction from the year's mortality of 29 visitors and 37 children under five years of age leaves a very small death-rate among the more advanced in years.

Respective Ages of Deaths in 1865–70.

Age.	Deaths.					
	1865.	1866.	1867.	1868.	1869.	1870.
Under 1 year.....	30	15	27	22	15	25
1 year and under 5 years.	16	7	3	9	22	7
5 „ 10 „ .	2	5	3	4	3	1
10 „ 20 „ .	3	5	6	7	7	6
20 „ 30 „ .	4	4	5	8	3	6
30 „ 40 „ .	4	4	11	9	7	11
40 „ 50 „ .	2	5	13	7	12	10
50 „ 60 „ .	5	7	7	7	14	9
60 „ 70 „ .	9	6	14	10	15	14
70 „ 80 „ .	7	11	7	7	11	13
80 „ 90 „ .	3	1	8	4	10	2
90 „ 100 „ .	5	—	—	—	2	—
	90	70	104	94	121	104

RAINFALL AND DEATHS IN EACH MONTH.

	1867.		1868.		1869.		1870.	
	Rainf'l.	Deaths.	Rainf'l.	Deaths.	Rainf'l.	Deaths.	Rainf'l.	Deaths.
January.....	2·86	10	2·57	15	5·06	7	2·11	4
February...	1·94	8	1·67	9	2·84	14	2·30	11
March.....	2·06	12	1·66	8	1·45	7	1·74	9
April.....	2·81	10	2·23	8	1·62	12	0·63	9
May.....	3.03	10	2·61	4	5·90	13	1·22	11
June.....	1·06	9	0·36	3	1·25	8	0·70	7
July.....	2.47	5	1·19	10	0·60	15	1·32	9
August.....	2·09	7	5·13	10	1·21	12	1·74	9
September.	2.89	8	3·20	5	5·80	8	1·35	9
October.....	2·66	6	2·12	9	1·83	6	4·17	14
November..	1·30	12	2·29	10	2·41	11	2·90	5
December..	1·19	7	6·09	3	4·12	8	1·80	7
	26·16	104	30·82	94	34·09	121	22·	104

The above table does not enable us to draw any conclusive inference as to the fall of rain and the death-rate *in Malvern.* This may be accounted for by the facts recorded in the previous tables, which show that, whatever the *fall* of rain, the *humidity of the atmosphere* is never considerable, a fact, as before explained, arising from the gravelly and porous nature of the soil, and the rapid escape of the rain into the valley below. In a reference to the above table also it must be noted that 1869 was the exceptional year of zymotic outbreak, not merely in Malvern, but throughout the kingdom. Rain, within due limits, may be viewed as a salutary agent.* When it does mischief, the mischief arises from its disturbance of masses of malaria-producing

* DEATH AND RAIN.—The following remarks are deserving of consideration :—

"Rain on the whole would seem to exert a kindly and healthy in-

deposits which are in this way dissolved and conveyed to adjacent wells and springs, impregnating the water with germs which generate various forms of fever and other zymotic diseases. The removal of masses of decayed vegetable or animal substances, and especially when contiguous to wells or springs, is a matter of primary hygienic importance. The same remark, of course, equally applies to drains and any escape arising from their imperfect construction.

The average mortality in Malvern may now be ascertained on the data adduced. These resolve themselves into two sections—the years 1864–66, as tabulated by Dr Johnson; and those given by myself, which extend over the years 1867–70.

The population and death-rate in Malvern, during the years 1864–6, according to the estimate of Dr Johnson, was as follows:—

Population.	Deaths.		
	Residents.	Visitors.	Total.
(1864) 6610	104	24	128
(1865) 6809	73	17	90
(1866) 7012	35	35	70

fluence. There is nothing very deadly in it. It may occasion catarrhs and rheumatic complaints, but these are curable with a little management and medicine. And we are to put to its credit the washing away of many of the most injurious causes of disease by a good flushing of the sewers. Summer diarrhœa, cholera, and typhoid fever would be likely to be greatly lessened by a copious rainfall. Dr Trench, the medical officer of health for Liverpool, has satisfied himself by a series of careful observations extending over a number of years, that there is an inverse ratio between the amount of rain and the amount of mortality from infantile summer diarrhœa. To the same effect are the tables given by Mr Macpherson, illustrating the relation of moisture to the mortality from cholera in Calcutta. The high mortality of 1854 was due, if we are rightly informed, to cholera. It is interesting to notice that in that year the rainfall was 32·7 per cent. below the average, while the mortality was 36·6 in excess

The average estimate made on the years 1867–70, is based on the population return of the census of 1871, which is 7606. The census was taken on the 3d of April, when Malvern had only a small number of visitors, and not a few of its residents were from home. Under these considerations an estimate based on 7000 of a resident population, and 8000 of a population inclusive of residents and visitors, is as near an approximate as can be made.

	Population 8000—residents & visitors.	Population 7000—residents only.
1867.....	13	11·7
1868.....	11·7	10·5
1869.....	15·1	13·1
1870.....	13	11·7

The average of the four years 1867–70 will be :—Residents and visitors (population 8000), 105 deaths, or 13 in each 1000; residents only (population 7000), 82 deaths, or 11·7 in each 1000.

Other considerations connected with an estimate of the death-rate among the resident population are important. A considerable proportion of residents are invalids who take up their abode in the locality on the ground of health, and whose lives are therefore precarious; or individuals who become residents at an advanced period of life, after an arduous professional or commercial career. The deduction on these items from the native population is considerable, as tested by a reference to the documents of the district registrar.

In the next section a comparison will be made of the death-rate of Malvern and various inland and seaside watering-places. It will be then shown that it is lower than the various health-resorts

of the average. It is quite probable that the comparatively small mortality from cholera this year, with which hitherto we have escaped, is due to the excessive rainfall of the summer and autumn months."—*The Lancet.*

selected as the most healthy of the marine residences, and less than Leamington, Cheltenham, Matlock, Buxton, Harrogate, and others of inland repute.

XV.—Comparison with other Health-Resorts.

A comparison of Malvern with other health-resorts is not necessarily invidious. Torquay, Ventnor, Bournemouth, Leamington, Cheltenham, Bath, Clifton, Tunbridge Wells, Hastings, and other equally celebrated health-resorts—each may present different atmospheric conditions, depending on height, aspect, temperature, humidity, or other circumstances of great importance to the invalid. The selection of climate is often very difficult to decide, and experience alone can decide in individual cases. There are certain general conditions, however, which constitute a sufficient guide. In some forms of disease a dry and tonic atmosphere is essential; in others warmth is a potential element; while to most an equable climate is indispensable. Few influences are more detrimental to delicate invalids than sudden atmospheric changes. Hence the fatal influence on life of transitions in variable climates from heat to cold and damp; and in particular when there is no provision for adequate clothing. An example is elsewhere given, in the climate of Nice, where we are told that "one instant you are sweltering in the sun; the next the cold gusts, whistling down through the snowy Alps, are cutting you like razor blades."* Exposures of this nature in pulmonary and bronchitic affections, where there is

* Contrast, as another example, the winter of 1869–70 of Malvern and Cannes. A letter from the latter celebrated health-resort, dated March 7, 1870, states :—"Such bad weather has not been known since 1848. Such wet—such want of sun—in fact, such a changed climate I never saw. For some days we have been enjoying better weather, mild and sunny, and the gardens are recovering. Still great damage has been done by the cold—the geraniums for the most part destroyed, and all the delicate trees which usually live through the winter." The prevailing winds of

proneness to mischief in delicate organs, are fatal in their influence. Warmth is not always the essential element in such disorders—certainly not so much so as freedom from atmospheric transitions. An equable climate, therefore, is the first consideration.

FALL OF RAIN.

The number of days on which rain fell in the years 1866–70, and the average amount of fall, is given below. The record kept in Malvern has been a more than ordinarily severe one, including a considerable number of days on which the fall of rain was very small, or only during the night. On glancing at the table given, it will be seen that the *fall* of rain in Malvern is not greater than in places in which the number of days on which rain falls is noted as much fewer. Take a few examples in the year 1867–68.

Place.	1867.		1868.	
	Days.	Fall of Rain.	Days.	Fall of Rain.
Malvern	189	28·67	183	30·82
Bath.....	160	30·45	160	30·45
Clifton.....	172	33·97	180	34·11
Ryde.....	128	29·66	134	33·11

The *fall* of rain is thus seen not to be considerable; its rapid

the same winter in Malvern, will be seen in the tables already given. Relatively severe as the winter was in Malvern (and throughout entire England), not a single plant or shrub, so far as the writer can ascertain, was injured or destroyed, and the influence of the weather on the foliage was seen only to a trifling and limited extent. The evergreen hedges and garden shrubs were in full and verdant foliage during the entire winter.

escape, however, is remarkable. This arises partly from the sloping position of the place, and partly from excellent drainage, and the porous and gravelly nature of the soil.

AVERAGE RAINFALL AND NUMBER OF DAYS ON WHICH RAIN FELL IN THE YEARS 1867–8–9–70.

	Inches.	Days.	Height.
Malvern	28·34	173	522
West Malvern	28·43	—	900
London—Camden Town	24·11	145	100
Bath	29·27	155	112
Torquay	35·53	165	205
Penzance	36·98	182	94
Ventnor	25·29	120	100
Ryde	30·11	126	20
Bournemouth	28·34	152	110
Tunbridge Wells	34·68	121	595
Hastings	27·14	—	212
Clifton	31·92	172	192
Cheltenham	26·11	134	232
Leamington	23·22	146	195

The number of days on which rain fell in Malvern is registered 172. Twenty-two of these registered only one-hundredth of an inch, indicating only a slight shower. Of the remaining 150, during forty-six the rain fell at night only. The actual number, therefore, of rainy days was 104. In any hygienic estimate, however, the *amount* of rain that falls does not—as will be shortly more fully shown—constitute the chief consideration. The moisture *retained in the atmosphere during the twenty-four hours*, and therefore in constant contact with the body, is *the* point of therapeutic value. It is the humidity of the atmosphere, combined with sudden severe atmospheric changes, which chills and kills, and not the cold only. The actual fall of rain in Malvern is as great as in many other places—or even more than some—but the humidity of the atmosphere in Malvern is less,

and more *equally distributed throughout the entire twelve months.* Perhaps it may be said that the equable dryness of the Malvern air forms the chief characteristic of its climate. At all events, it constitutes an essential element in climatic considerations.

HUMIDITY.

Equally if not more important, as previously urged, in a hygienic point of view, is the *humidity* of the atmosphere—*i.e.*, the relative amount of *moisture* in the air, apart from the *fall* of rain. To appreciate this portion of our subject, it must be understood that the atmosphere is in a complete state of saturation when the moisture is 100. Mr Duncan observes, that if the humidity at 9 A.M. and 9 P.M.—when the temperature is about the average of the day—is 73, "the air to an inhabitant of Great Britain would feel very dry, 73 being about the lowest mean humidity that occurs in Scotland during May, the driest month." Mr Duncan adds, that this low humidity is greatly exceeded when the east winds of spring happen to acquire their greatest virulence and dryness.*

HUMIDITY.

	MALVERN.				BOURNEMOUTH.				GREENWICH.	
	1867.	1868.	1869.	1870.	1867.	1868.	1869.	1870.	1867.	1868.
January	...	86	87	86	86	89	88	85	83	86
February	...	78	79	83	85	83	85	87	84	80
March	...	76	77	77	85	82	82	81	82	80
April	78	69	77	65	84	81	82	76	80	78
May	72	65	79	75	78	80	83	80	74	74
June	69	60	74	60	72	70	79	70	75	68
July	69	59	72	79	78	68	81	76	76	63
August	69	72	72	74	79	78	72	77	80	73
September	73	73	75	79	75	78	78	79	81	74
October	82	80	81	86	83	83	81	83	88	88
November	79	83	82	83	81	85	85	86	87	87
December	85	88	85	85	85	91	86	86	89	90
MEAN	...	74	78	77	81	81	82	80·5	82	79

* *Handbook of Meteorology*, p. 163.

The above tables exhibit a condition of the atmosphere which exercises a potent influence on the climate of Malvern. Greenwich slightly exceeds Bournemouth in dryness, while Malvern in this respect has the advantage over both places, and this, it will be remarked, is specially noticeable during the winter months, a period when Malvern has been erroneously supposed to be unsuitable as a residence.

TEMPERATURE.

The following tables will give a comparative estimate of the range of temperature in a few places of note as health-resorts:—

Mean temp. at Greenwich	49·4	Mean temp. at Ventnor	51·7
„ „ Clifton	49·2	„ „ Malvern, 1868	51
„ „ Worthing	49·9	„ „ „ 1869	49·2
„ „ Bournemouth	49·9	„ „ „ 1870	49·3

The difference in temperature during the five most adverse months of the year are as follows:—

Month.	Malvern.		Ventnor.	Worthing.	Clifton.	Greenwich.
	1868.	1869.				
November	41	43·9	48·0	46·4	44·0	44·0
December	44·9	37·6	43·7	42·1	41·1	40·5
January	37·5	41·0	41·3	39·6	38·7	38·1
February	43·1	44·7	41·6	39·6	39·3	38·9
March	44·8	38·8	44·2	42·3	41·6	41·5

THE MORTALITY IN MALVERN COMPARED WITH THAT IN MARINE AND OTHER INLAND HEALTH-RESORTS.

The average death-returns of Malvern bear favourable contrast with our marine as well as inland health-resorts.

The following table is extracted from the Quarterly Return of Marriages, Births, and Deaths, published by authority of the Registrar-General, 1871:—

Mortality in Districts or Sub-districts containing the principal English Watering-Places.

Watering-Places.	Population, 1871.	Deaths registered in the Quarter ending 30th June 1871.	Annual Rate of Mortality per 1000 living.			Districts and Sub-districts taken as approximately representing the Watering-Places.
			In Ten Years, 1861–70.	In Quarter ending 30th June 1871.	From Seven Principal Zymotic Diseases in June Quarter 1871.	
38 Seaside Towns.	756,076	3,453	20·2	18 3	2·2	
9 Inland Towns..	286,991	1,268	20·3	17·7	2·0	
Total.....	1,043,067	4,721	20·3	18·1	2·1	
SEASIDE TOWNS.						
Whitby	15337	67	24·2	17·5	1·3	Whitby sub-district.
Scarborough.....	26380	134	23·4	20·3	2·3	Scarborough ,,
Yarmouth	43698	168	22·5	15·4	1·9	Yarmouth district and Gorleston sub-district of Mutford.
Lowestoft.....	17213	68	19·2	15·8	·7	Lowestoft sub-district.
Southend	6759	27	16·6	16·0	1·8	Prittlewell ,,
Herne Bay	5359	20	20·5	14·9	3·0	Herne ,,
Margate	13963	58	22·0	16·6	·9	Margate ,,
Ramsgate.....	23778	100	18·1	16·8	1·2	Ramsgate ,,
Dover	24033	105	19·2	17·5	1·5	St James ,, St Mary ,,
Folkestone.....	19580	60	16·4	12·3	1·6	Folkestone ,,
Hastings & St Leonards.....	31359	158	19·4	20·2	2·2	All Saints and St Mary sub-districts.
Eastbourne.....	12954	58	17·0	17·9	1·5	Eastbourne sub-dist.
Brighton	90013	442	22·0	19·6	2·6	Brighton district.
Hove	25497	102	16·2	16·0	2·5	Shoreham sub-district.
Worthing..... Littlehampton	17249	66	17·6	15·3	·2	Worthing and Littlehampton sub-dist.
Isle of Wight.....	66165	285	17·2	17·2	1·7	Isle of Wight district.
Weymouth	14702	104	20·3	28·3	11·4	Weymouth sub-dist.
Sidmouth.....	11641	47	18·6	16·1	·3	Ottery St Mary ,,
Exmouth	7538	37	19·6	19·6	3·7	Exmouth ,,
Dawlish and Teignmouth.	12236	49	18·8	16·0	1·3	Teignmouth ,,
Torquay	28311	103	18·8	14·6	2·3	Torquay ,,
Penzance ..... Marazion ..... St Ives.....	53969	260	22·5	19·3	2·9	Penzance district.
Ilfracombe.....	6403	25	17·1	15·6	3·1	Ilfracombe sub-dist.
Weston-super-Mare.....	15121	50	18·7	13·2	·8	Banwel ,,
Tenby.....	9688	42	18·2	17·3	·8	Tenby ,,
Aberystwith.....	10088	62	22·7	24·6	3·6	Aberystwith ,,

Watering-Places.	Population, 1871.	Deaths registered in the Quarter ending 30th June 1871.	Annual Rate of Mortality per 1000 living.			Districts and Sub-districts taken as approximately representing the Watering-Places.
			In Ten Years, 1861–70.	In Quarter ending 30th June 1871.	From Seven Principal Zymotic Diseases in June Quarter 1871.	
SEASIDE TOWNS.						
Bangor & Beaumaris	36580	171	22·0	18·7	2·4	Bangor district.
Anglesey	35090	178	21·1	20·3	1·6	Anglesey ,,
Llandudno	8779	51	19·2	23·2	·5	Creuddyn sub-district.
Rhyl	12719	76	21·9	23·9	2·5	St Asaph ,,
New Brighton	14779	81	18·4	21·9	4·6	Wallasey ,,
Southport	22271	129	23·1	23·2	3·2	North Meols ,,
Blackpool	16816	70	21·2	16·7	1·0	Poulton-le-Fylde s.-dis.
INLAND TOWNS.						
Tunbridge Wells	24748	91	17·2	14·7	4·0	Tunbridge Wells sub-district.
Bath	54480	304	23·3	22·3	2·7	Bathwick, Abbey, Lyncombe, Walcote, and Lansdown sub-dists.
Clifton	101637	382	20·0	15·0	1·7	Clifton, Ashley, St George, St Philip and Jacob sub-districts.
Cheltenham	41923	177	19.9	16·9	1·3	Cheltenham sub-dist.
Malvern	13808	84	20·2	24·3	·6	Hanley Castle ,,
Leamington	22730	113	19.4	20·8	1·4	Leamington ,,
Buxton	6229	26	20·8	16·7	3·2	Buxton ,,
Matlock	10607	41	19.6	15·5	1·5	Matlock ,,
Harrogate	10829	45	18.4	16·6	1·1	Harrogate ,,

In presenting the above statistical table, the Registrar-General remarks on the "unusually healthy" condition of English watering-places, and adds:—"Many English people naturally resort to foreign countries to pass their holidays for various valid reasons; but neither they, nor any others in search of health, can find healthier places than in England. Germany has her Rhine, great as the river of a small continent can be, but without the grandeur, variety, and freshness of the sea encircling the English coast: here the green grass, flowers, and foliage can fairly compete not only with the dry, hot, dusty air of conti-

nental towns, but with the choicest resorts of the country. . . . The salubrity of the English watering-places admits, too, of improvement, but all the sanitary arrangements contrast favourably with the inconveniences and insalubrities abroad."

In one of the columns of the table of the Registrar-General is given an average of mortality during a period of ten years—*i.e.*, from 1861 to 1870, in various inland and marine health-resorts. The average is taken not upon the spring quarter, but on the *whole year.*

Inland Watering-Places.		Marine Watering-Places.	
Bath (Bathwick, Abbey, Lyncombe, Walcot, and Lansdown sub-district)	23·3	Whitby	24·2
Clifton (Clifton, Ashley, St George, St Philip and Jacob sub-districts)	20·0	Scarborough	23·4
Buxton	20·8	Southport	23·1
Cheltenham	19·9	Brighton	22·0
Leamington	19·4	Aberystwith	22·7
Matlock	19·6	Bangor and Beaumaris	22·0
Harrogate	18·4	Margate	22·0
Tunbridge Wells	17·2	Weymouth	20·3
Malvern, a sub-district in Hanley Castle district, including the parishes of Hanley Castle, Madresfield, Newland, Welland, Powick, Little Malvern, Great Malvern, and the County Lunatic Asylum, Powick)	20·2	Rhyl	21·9
		Blackpool	21·2
		Exmouth	19·6
		Llandudno	19·2
		Hastings and St Leonards	19·4
		Dover	19·2
		Lowestoft	19·2
		Ramsgate	18·1
		Sidmouth	18·6
		Dawlish and Teignmouth	18·8
		Torquay	18·8
		Weston-super-Mare	18·7
		Tenby	18·2
		Folkestone	16·4
		Eastbourne	17·0
Great Malvern (including visitors and residents)	14·5		

The Registrar-General, in his able and laborious report, unfortunately gives the death returns of Malvern on the returns for Hanley *district—i.e., the entire deaths in seven parishes, inclusive of the deaths in the county lunatic asylum.* The deaths registered as occurring in the county lunatic asylum alone

often exceed the deaths in the whole of Great Malvern parish.*

The following is an analysis of the deaths in Great Malvern parish alone, during the spring quarters (April, May, June) of 1867–70. It is given with a view to comparison with the spring quarters of other health-resorts, inland and marine, as tabulated by the Registrar-General :—

	1867.	1868.	1869.	1870.
April.....	10	8	12	9
May.....	10	4	13	11
June.....	9	3	8	7
	29	15	33	27

Total in four years, 104; population, 8000—*i.e.*, 3·25 in each 1000, or an average of 13 in the year, including in the estimate visitors as well as residents.

The mortality in Malvern, during the spring quarter of 1871, does not exhibit any material difference between Weston-super-Mare, Clifton (divested of its extra sub-districts), Torquay, and two or three other health-resorts. Malvern has, however, the advantage. This fact requires more to be noticed, because the spring months are ordinarily supposed to be unfavourable for Malvern residence.

It may be well to adduce, by way of final comparison, a few examples of the rate of mortality in our large towns :—

* The deaths recorded in the Registrar-General's return for 1870, in the district of Hanley, and given under the head Malvern, are 280. Of these not less than 80 died in "public institutions," not one of which exists in the parish of Malvern. In the spring months of 1871 (April, May, June) the deaths are recorded as 84, and of these 25 occurred in "public institutions."

MORTALITY IN LARGE TOWNS.

Cities and Boroughs.	Estimated population in the middle of the year 1871.	Average rate, in 1000 living persons, during 10 years 1861–70.
London (Registrar-General)	3,263,872	24·3
Liverpool (borough)	494,649	33·5
Manchester (city)	356,099	30·2
Salford (borough)	125,422	27·0
Birmingham (borough)	344,980	24·8
Wolverhampton (borough)	68,476	26·1
Leeds (borough)	260,657	28·0
Sheffield (borough)	241,507	27·2
Bristol (city)	183,298	22·5
Newcastle-on-Tyne (borough)	128,677	28·2
Hull (borough)	122,266	24·9
Bradford (borough)	146,987	26·2

A comparison of the death-rate of inland and marine health-resorts does not lead to any very practical result. The average of a selected number of inland and sea watering-places is nearly the same. The mortality in various celebrated marine resorts, however, as for example Whitby, Scarborough, Southport, Brighton, Aberystwith, Bangor, Beaumaris, and Margate, considerably exceeds that of the inland towns. Malvern unquestionably has the lowest average rate of mortality of any watering-place, inland or marine, and may fairly lay claim to be the healthiest health-resort in England. Clifton follows closely in its wake; Folkestone, Southend, and Eastbourne rank next, and then come Weston-super-Mare, Torquay, Tenby, Sidmouth, Ramsgate, and other places. Of inland towns, Edgbaston, a suburb of Birmingham, is one of the most healthy, the deaths in each 1000 of the population not exceeding 13. Edgbaston, however, consists almost exclusively of the houses of rich merchants, whose dwellings possess every hygienic advantage, and must be compared with Malvern and its resident

population only—*i.e.*, a death-rate of something over 11 per 1000.

The relative advantages of marine and inland health-resorts is a point to a large extent to be determined by medical considerations. The therapeutic influence of moist and dry air has received brief consideration in a previous section. In any climatic estimate, we must bear in mind that sea-air lessens cutaneous and pulmonary evaporation. The evaporating power of sea-air is 20 per cent. less than the air of inland districts.

Marine residences, under certain conditions of climate or season, do not receive medical sanction. Dr Copland, in his "Dictionary of Medicine," a high authority on subjects of hygienic consideration, makes the following remarks:—

"In warm climates, and even in many temperate countries, during warm seasons, places on or near the sea-coast are more productive of insalubrious exhalations than inland districts, owing not merely to their being more nearly on a level with the sea, and subjected to a denser and more moist atmosphere, but chiefly to the circumstance of the soil in such localities being more deep, rich, and absorbent; more liable to inundations from heavy rains or swollen rivers, and from the sea itself; more fertilised by the decay of animal and vegetable bodies, and hence more productive of the elements of unwholesome exhalations when their extrication is favoured by a hot sun, and their retention and accumulation in the air are promoted by its more constant and greater humidity. The currents of air that, during the heat of the day, pass from the ocean more or less loaded with moisture, return to it in the night, charged not only with humidity, but also with terrestrial emanations, thus rendering places situate in the vicinity of the sea, and nearly upon the same level, more insalubrious than the elevated district inland."

These conclusions harmonise with those of Celsus, the great physician (the contemporary, probably, of Ovid and Horace)

—"Generally everywhere, wind coming from inland countries is healthy; from the sea unwholesome."

How far the drawback to sea residence in modern marine health-resorts is attributable to the barbarous system of sewage deposit in the water, is a matter for hygienic investigation.

Although localities such as those to which Dr Copland refers —"places *on* or *near* the sea-coast"—are more productive of insalubrious exhalations than inland districts, yet there are considerations which lead to the supposition that sea-winds passing up the rivers from the coast act as hygienic ventilators, dispersing and driving away miasmatic products. Possibly we have not yet sufficiently estimated the healthful influence of atmospheric sea-currents on inland positions, and these bi-diurnal in their occurrence, as influenced by tidal ebb and flow. Malvern has a decided advantage in not being close to a river, and not having its atmosphere saturated with river exhalations. It seems, however, not improbable that the winds, influenced by river or tidal currents, may have an effect on the air of the place, and in particular those valley-winds which manifestly come from the sea.

In previous tables it has been shown that the average mortality in Malvern is more than one-third less than in Whitby, Scarborough, Southport, Brighton, Aberystwith, Weymouth, Margate, and some other well-known sea resorts. These localities, on the whole so deservedly frequented, are the special resorts of invalids, and possess, we may presume, every hygienic advantage such as drainage, water supply, and superior house accommodation. Brighton, for example, is one of the best locally governed towns in the kingdom, its authorities having paid unusual attention to its sanitary condition, and yet its death-rate (including in each place the deaths of visitors and residents) is more than one-third greater than that of Malvern. To what circumstances are we to attribute this result? Not to dwellings, drainage, or food supply —which may be considered in the above fashionable resorts as equal—nor in population, for a large town is not necessarily

unhealthy, but to other hygienic conditions dependent on air, wind-currents, elevation, atmospheric humidity, &c.

XVI.—Diseases in which the Climate of Malvern is found to be Advantageous.

Those disorders which derive benefit from a comparatively dry and bracing air, free from undue moisture and cold depressing fogs—with few of those sudden transitions of temperature which are so trying to a large class of invalids—derive benefit from a sojourn in Malvern. As a summer residence, it has been celebrated for its hygienic claims, but its value as a winter resort requires yet to be known. I believe that to a very numerous class of health-seekers, few winter residences present a more genial climate or greater number of hygienic advantages. A slight reference to the meteorological tables in preceding sections will confirm this view, and the experience of delicate invalids is abundantly confirmatory. The relatively delicate plants that flourish uninjured during the winter months present additional and unerring evidence. I have little doubt that Malvern will be ranked among the first of winter residences, as its climate becomes known, and its advantages are more fully appreciated. Even within the last few years its number of winter residents has very largely increased. I now give a brief sketch of a few of those disorders in which the Malvern climate has been found to be advantageous.

THE DEBILITY AND OTHER INFLUENCES OF TOWN-LIFE.

There are certain conditions on which health mainly depends —the *vital stimuli*, such as *food*, *air*, *light*, and *heat*. Besides these we may add *exercise*, as essential to vital action; and *rest* or *sleep*, as essential to vital restoration. The due influence of each and all of these agencies constitutes in the aggregate what we call health. The absence of these conditions—in whatever

degree, so far as that absence extends, if it does not induce disease—creates that state of the system which predisposes to its reception. The lack of good food, of pure air, of exposure to light, and genial warmth, together with a limited extent of exercise by day, and inadequate amount of rest by night—these adverse influences, although they may be gradual, induce those slow and silent changes which too frequently escape early observation, but which lower the whole vital action, and reduce the body to a condition which renders it unable to cope with even ordinary attacks of disease.

Town or civic life has its special hygienic conditions. These result in an equally special type of disease, largely asthenic in its character, for which a residence in Malvern or some similar locality affords the specific remedies—those mainly derived from a due supply of the vital stimuli. Reference to a few of these characteristic influences may be desirable, as illustrative of the effects of climate on health.

Imperfect digestion ranks among the foremost of civic disorders. This hydra-headed condition may arise from various causes—such as irregular meals, quick eating, indulgence in improper articles, breathing a vitiated and over-heated atmosphere; but, most of all, mental worry and excitement. It is remarkable how a brief residence in a healthy district, with regular meals, consisting of plain nutritious food, freedom from mental anxiety, and abundant out-door exercise, relieves the stomach of many of its conditions of disquietude, gives rise to a more natural appetite, energises the power of digestion, and invigorates the whole animal functions.

"Atonic dyspepsia" is a form of gastric derangement which derives much benefit from a residence in Malvern. The tonic effects of the air appear to exercise a powerful remedial influence in such cases, and in particular, as is generally the case, when associated with nervous exhaustion; for nerve power, as elsewhere urged, is dependent on digestion and nutrition, and in every case

the restoration of nervous energy must be preceded by an improved condition of the digestive functions.

General weakness, anæmia, or bloodlessness, is the prevailing condition of the mass of the civic population. This condition doubtless arises from sedentary occupation, from a relatively impure atmosphere, from the absence of exposure to light and other solar influences, from irregular dietetic habits, from imperfect digestion and nutrition, and consequent deteriorated quality of the blood. In anæmic conditions, the diminution of the red corpuscles in the blood is remarkable. The average per 1000 of these essential constituents, in a state of health, is 127. In cases of impoverished blood the number has been reduced to 27, while at the same time there exists a manifest lack of hæmatine. Hence the pale and lifeless appearance of the skin. The highest medical authorities state, among other potent causes of anæmia or deficiency of blood, "deprivation of fresh air and light; the effect of this can scarcely be over-estimated. Even the best food will not be converted into healthy blood if light and air are withheld, while a coarse and insufficient nutriment will not prevent a person from having a ruddy colour, if he be much in the open air." *

Civic blood may be defined as impoverished blood—blood which lacks the essential elements of nutrition. In many cases the pale skin, the livid lips, the spongy gums, and flabby tongue, exhibit manifest absence of fibrin and iron in the blood, while the shrunken and powerless muscles show a want of nutrition and due aeration. The contractions of the heart are feeble, often irregular, the pulse weak, and brain action in a number of cases can only be roused to necessary effort by the stimulus of wine. In such cases there is a want of muscular and nervous power exhibited in the condition known as general debility, in addition to diminished or imperfect animal temperature. The whole

* "Pathological Anatomy," by Drs Jones and Sieveking, p. 59.

being, animal and intellectual, is below par. Each is equally unequal to vigorous effort. In some cases—the number is not a limited one—the life of an individual may be called *existence;* but it is a low grade of life in every sense, infinitely below the normal standard. In the bodily sense it is one that is too fragile to bear the adverse influences of active existence, and hence the free mortality which prevails among this class of individuals.

In such conditions there exists only one cure—exposure to influences the reverse of those which are health-antagonistic in our large towns. The brain cannot perform its allotted work if it is not supplied with blood abundant in quantity, and possessing also its normal constituents. Nor can good blood be manufactured under unhealthy influences, or from insufficient materials. Various adverse causes are at work at the same time. Mental harass enfeebles nervous action, and nerve power constitutes the basis of sound nutrition. Sound digestion, and consequently the formation of good blood, is incompatible with the wear and tear of excessive business disquietude, and without good blood the brain is unequal to successful effort. The blood governs the brain, because it supplies it with power of action; and the brain governs the blood, because the blood is manufactured under nervous influence. The cure lies in "ceasing to do evil and learning to do well," in relieving the mind from overstrain, and in supplying the body with its vital necessities. Rest is necessary to restoration; and however valuable various medical preparations may be, none can be substituted for those vital stimuli which are essential to healthy existence. In the absence of actual disease, and in cases where there exists only debility of the functions, the influence of regular hours, simple but nutritious diet, regulated exercise, freedom from brain work, breathing in a pure and tonic atmosphere, is marvellous. Nature rapidly recruits her exhausted energies; her recuperative powers increase with the renewal or recreation of the blood constituents;

and new tissue of a higher organised nature is accompanied with the possession of corresponding strength.

CHRONIC RHEUMATISM, GOUT, ETC.

However we may differ with an eminent physician who, when asked what was good for acute rheumatism, replied "Six weeks," there can be no doubt that means as well as time are required to cure chronic forms of this painful malady. It is a disease which has its seat mainly in the fibrous tissue of the joints, and is one considerably influenced by the condition of the digestive functions, and also by climatic exposure and variations. Rheumatism, like a vast number of prevalent maladies, may be characterised as a blood disease, a low condition of the vital fluid rendering the system recipient of rheumatic influences, such as damp and cold; and not improbably, in many cases, during adverse exposure, the introduction into the blood of a specific poison—a poison which, by some elective influence, fixes its seat in the fibrous tissue. The cure may be partly a restoration of the digestive functions and the formation of a better quality of blood; partly the administration of therapeutic remedies, such as appropriate medicines, frictions and water applications; but in many cases all remedies fail except they are accompanied with a change of climate. In that type of chronic rheumatism which is called *passive*, this is more especially the case. Pain is soothed by regulated friction, and the symptoms are relieved by free action of the skin. Warmth, also, is palliative to a remarkable extent, or at least avoidance of those transitions of temperature which are frequent in cold and damp districts. The climate of Malvern, as a whole, is well adapted for persons afflicted with chronic rheumatism—in particular, those who reside in low and marshy situations, and where the winds are changeable and severe. Special winds may be called rheumatic winds. Occult atmospheric influences are soon felt by rheumatic patients. Persons suffering from this disorder can premonise by their feel-

ings changes of weather, not only many hours, but even days, before their actual occurrence. In these cases we must take into consideration various influences, such as the condition of the air, whether moist or dry; its influence on the skin, lungs, and on the secretions; the amount of ozone it contains, as well as the depressing influence of rapid atmospheric transitions. Each and all of these influences must receive due weight in the selection of climate for special forms of disease, and experience shows that the dryness of the Malvern air, the atmospheric pressure, its equableness of climate, and its comparative freedom from cutting winds, renders it a residence more than ordinarily suitable to persons suffering from chronic rheumatism. The author could cite a considerable number of cases in illustration. At the present period there are various residents in Malvern who have purchased properties in the place in consequence of the benefit they have derived from a limited visit, having long been sufferers from this disease. In one case the cure was effected by a change of residence from Leamington, a town so celebrated for its attractions as a health-resort, and apparently possessing a climate more approximating to that of Malvern than many other inland resorts.

NERVOUS DISORDERS,

in many of their forms, derive great benefit from a residence in Malvern. A large type of nerve-derangement arises from poverty of blood, and is purely asthenic in its character. Many of its victims are hothouse plants, living in an artificial atmosphere, rousing themselves to temporary energy by recourse to stimulants, calling that life which is merely existence, and seeking the relief from external remedies which conformity to the laws of nature can alone accomplish. In this state, exercise, pure air, regular habits in diet and sleep, gentle tonic and restorative baths, soon effect relief, and in good time a cure.

Malvern air certainly is beneficial in various forms of paralysis

—those arising primarily from functional derangement and from exhausting influences. I could adduce many cases in illustration did space permit.

STRUMOUS AFFECTIONS.

Scrofula is unquestionably in all its forms a disease of the blood, chiefly based on imperfect nutrition. Whatever its outward manifestation,—whether exhibited in glandular swellings, in morbid conditions of the eyes, known by the name of strumous ophthalmia, or in those sluggish forms of ulcerations which are so difficult to cure,—the cause lies in the blood, and the cure depends on those vital conditions of air, food, digestion and nutrition, which improve the quality of the vital fluid, and increase the action of the organs of elimination. I have seen numerous cases of intractable ulcers, which for years have resisted ordinary remedies and the atmosphere of towns, rapidly heal after a few weeks' or months' exposure to Malvern air and good nutritious food, in combination with judiciously adapted water applications. In another section some remarkable cases of cure in strumous affections are given from old writers. We are told of the springs of Malvern, to which "people in troops resorted," "how they help sore eyes with a new found well." Again, such was the repute of Malvern water in olden time in the cure of strumous ulcers, that in the absence of lodgings, many

> "To drink thy waters' store,
> Lie in thy bushes;
> Many with ulcers sore,
> Many with bruises"

"succour find." Modern experience tends to the conclusion that Malvern air, as well as Malvern water, has something to do with these olden cures.

I have had numerous cases of strumous ophthalmia under care in Malvern with eminently successful results. In these cases, the

remedies used have been mild hydropathic applications, abundant nutritious food, constant out-door exercise without fatigue, with occasionally mild preparations of iron and cod-liver oil.

Multitudes of cases occur in which, without any manifestation of local disease, there exists what may be called the *strumous diathesis*. The signs of this condition are characteristic, and easily recognised. The skin is pale and delicate, and often almost transparent; the blood vessels are prominent; the cheeks, usually pale, readily flush under excitement; the muscles are flabby, weak in power, and can bear but little exertion; the action of the heart is feeble; the pulse is quick and irritable; the appetite is variable and capricious; the tongue is flabby, often coated, and the papillæ are raised and red; the breath is ordinarily offensive; the glands of the neck are often enlarged; the bowels are distended and tender to the touch; the eyes are prominent, and liable to inflammatory attacks which are purely strumous in their character; the temperament is usually excitable; and the mental characteristics are precocious, so much so as to excite the almost proverbial remark on their early death, as "too clever to live." These cases derive immense advantage by a residence in Malvern, and subjection to hygienic laws. To ensure their complete recovery, they must live almost a purely animal life, like the sheep on the hill sides, breathing constantly the pure air, and eating the most simple but nutritious food.

DEBILITY IN CHILDREN.

I have noticed in children, after a few weeks' residence in Malvern, increase of appetite and corresponding increase of nutrition; caused, doubtless, by an increase in the activity of the vital functions. The change of tissue becomes more rapid, blood-making improves from day to day, morbid conditions, or rather predispositions in the blood, are removed, and strength follows.

The rapid improvement of children suffering from anæmia after even a brief residence in Malvern, probably arises from the more thorough oxidisation of the blood, and consequent formation of higher organised tissue. Children in whom there is feeble action of the whole organism, who have poor appetites, and equally poor digestion, whose blood formation is therefore imperfect, under the influence of Malvern air, from whatever cause it derives its peculiar characteristics, rapidly improve in appetite, digestion, weight, and strength. The red corpuscles increase in equal proportion, and the pale and lifeless skin assumes its more healthy and vital appearance.

Since penning the above remarks, and those also made in another section, I have met with confirmative evidence from Dr Brochard's work on "Sea-Air and Sea-Bathing for Children and Invalids," in which he gives an extract from an English writer, Dr Hamilton, of Lynn. Dr Hamilton attributed the frequent occurrence of scrofulous diseases which he met with in that place, to its low and damp situation. "If children born in the neighbourhood of Lynn," he remarks, "are sent to Malvern, or some other place where the air is pure, they almost always recover their health. Not that the air or the water of these places is to be considered as a specific for scrofula; but that change of air alone sometimes leads to cure, just as I have stated that scrofulous tumours or open abscesses are cured by a sojourn at the seaside, accompanied, after a while, by sea-bathing.* Unquestionably, as experience abundantly testifies, a change of air is strikingly beneficial in many forms of disease; but in strumous affections the air of Malvern possesses various qualities, as shown elsewhere, specially adapted to the cure—qualities dependent on its soil, its aspect, its height, its solar influences, the dryness and tonicity of its atmosphere, its freedom from miasmatic influences, and the purity of its water.

* "Sea-Air and Sea-Bathing," by Mons. le Dr Brochard, p. 107. Edited by Dr Strange. 1865.

DISORDERS OF WARM CLIMATES.

Long experience and close observation convinces me that Malvern is an admirable climate for the large proportion of invalids from India and other hot climates. Man by nature is capacitated to become a migratory animal. In ordinary health, and provided he adapts his clothing and food to the climate in which he resides, he may move from one portion of the globe to another with comparative immunity. What are the consequences, however, of transition from a hot climate to one of a temperate zone, *after long years of acclimatisation in the former?*

I have known numerous residents in India who have lived in that portion of the world thirty, and in one case forty years, with almost uninterrupted health, and have returned to this country, and resided in it with equal health and bodily vigour. These persons have adapted their diet, clothing, and exposure to the atmosphere, to the changing conditions of climate—in other words, have studied and conformed to physiological requirements.

Unquestionably the diseases of warm climates exhibit a peculiar type; but in a majority of the cases, the type of disease, or at least its aggravated and fatal form, is attributable to undue exposure and improper diet.

It is only a year or so after their return to England that Indian acclimatised residents usually suffer most from climatic change. It would seem as if the storehouse of heat was in that time expended, and that the vital power was unequal to further adequate effort. A little care, however, would enable such persons successfully to stage over the precarious and doubtful period. The first year is too frequently made a year of excitement, and a time of draw on the vital powers in other respects. Sufficient care is not had to diet, clothing, hours of rest, and attention to other means of health. The change is often felt in its first stage as stimulating and tonic, and induces too free

dependence on powers which a little prudence would strengthen and develop, so as to fit them for vigorous and permanent exercise.

Indian residents return to this country chiefly suffering from hepatic disorders—mainly those of congestion, from affections of the bowels—as for example chronic diarrhœa from jungle and other fevers, and from brain excitement, frequently induced by exposure to the sun. Cases of this nature in all their varieties have been treated successfully in Malvern, and during almost every period of the year. Indian patients generally, indeed, speak in warm terms of Malvern as a residence, chiefly on the ground of its pure and invigorating air, its equableness of temperature, and its comparative freedom from depressing damp and fogs.

The physiological changes from a warm to a cold climate are readily recognised, and with care may be modified and rendered comparatively harmless. Obviously the first influence of exposure to a colder atmosphere will be the constriction of the cutaneous blood-vessels, and the corresponding determination of blood to the inner organs, chiefly as experience proves of the viscera. Another cause of visceral engorgement will arise from the effects of cold in checking or diminishing the secretions, or rather excretions—as, for example, those of the skin and the liver. Again, the effects of cold and cold transitions must be estimated by their influence on organs which have been weakened by residence in a warm climate, and which are therefore predisposed to injurious influences. In this way, liver affections, lung derangement, and bowel disorders, occur after a return to England, which, by adequate precaution, and due physiological care, might have been altogether or in large measure prevented.

LOCAL CONGESTIONS.

In all ordinary cases where there exists local congestion, or a tendency to that condition, the Malvern climate is suitable during

the greater portion of the year. The air is moderately stimulating, while it is rarely severely cold. It is unusually free from fogs and other atmospheric moisture, and from those cutting winds which drive the blood from the surface, and compel it to seek refuge in the more vital organs.

LUNG CONGESTION.

The prelude of lung disorganisation ranks under this head. Invalids with this tendency should avoid foggy or damp situations, and in particular those where there is exposure to severe winds, and where the climate is variable. On this subject, however, more will be noted in a subsequent section. Cold is not so much an objection if unaccompanied with damp, and that sudden change in atmospheric temperature which is favourable to congestion.

In organic affections of the heart, Malvern is an undesirable locality, on the ground of the unevenness of its roads and its hill ascents, and in some cases on the ground of atmospheric pressure. In certain forms of brain congestion, and in a limited number of neuralgic cases, the air is found to be too stimulating. Some invalids describe it as living in "an atmosphere of quinine." A few individuals of excitable nervous temperament experience relief by resorting to the lower and heavier atmosphere of the valleys.

On the other hand, to the dwellers in valleys and residents by the seaside, a change for a few weeks to a mountain locality and more bracing atmosphere is generally attended with beneficial results. The inspiriting influence of such change can readily be explained, on the physiological grounds enlarged upon in previous sections. Professional attention, possibly, has not sufficiently been directed to the therapeutic influences of *change* of climate—the change for a few weeks of the seaside and lowland resident to a mountain or hill district, and of the denizen

of a higher region to the seaside and its less absorptive atmosphere.

It is not necessary at greater length to enumerate the various maladies which derive benefit from a residence in Malvern. Diseases where there is poverty of blood and general feebleness of the vital power, in low nerve condition with hypochondrical tendencies, nerve debility, cases of feeble digestion, and therefore imperfect nutrition; these, and similar disorders, receive marked benefit. In chlorosis I have witnessed most remarkable beneficial changes. In fact, I know of few cases of blood deterioration with which the Malvern climate does not agree. During winter, invalids even of exceedingly feeble strength derive the highest advantage; and the days are rare during which, on some part of the day at least, exercise cannot be taken. The nature of the soil, and the abundant drainage, as a rule, make the roads and hill walks comparatively dry and accessible.

The hygienic advantages of Malvern in particular, in relation to the peculiar suitableness of its climate to youth, render it, more than most other localities, a place fitted for educational establishments. Hence its large and successful college, and the rapid increase of its private schools.

XVII.—Malvern Climate in Phthisis.—The Hygienic Treatment of Consumptives.

Malvern, from its position, height, equableness of climate, purity of air, comparative freedom from cold winds and fogs, and excellence of its water, possesses more than ordinary claims to be selected as a sanatorium for consumptives. Its elevation is favourable as regards atmospheric pressure and freedom from miasmatic exhalations, its exposure during trying periods of the year to solar influences, the general absence of fogs and freedom from moisture, the free fall of rain, but rapid transit of the fall into the valley beneath; these and other considerations render Malvern a climate of high therapeutic value.

As a sanatorium for consumptives, Malvern has other and peculiar advantages. It comprehends four or five distinct districts, each possessing a modified aspect, and consequent exposure to, or freedom from, special atmospheric influences.

Great Malvern, as a central point, has a due exposure to the east and south, and the advantage of the early morning sun. Malvern Link has also a south-east exposure, with a lower elevation. North Malvern, with its northern aspect, has a temperature several degrees lower during the whole year. West Malvern, at a higher elevation than Great Malvern, has the afternoon sun, and by its position is protected from the influence of the east winds. Malvern Wells has an aspect similar to that of Great Malvern. Each of the Malverns, in house residence, and other hygienic requisites, affords superior advantages. Patients in the various stages of disease, and in the changing season, are able to move from one district to the other, so as to avoid prejudicial variations of winds, and to avail themselves of such influences as experience proves are favourable in differing stages of disease. Few if any localities in the kingdom possess such special claims in point of aspect and modification of climate, within a moderate area; one which admits from week to week, or even from day to day, of easy removal.

WHAT IS CONSUMPTION?

How does this disease originate? What are the conditions on which it depends? It may be defined to be *a disease of the blood*, induced by a combination of causes, in nearly every instance avoidable or capable of removal, the morbid deposits of which chiefly take place in the lungs. The phthisical tendency doubtless is hereditary. It may be handed down from parent to child, but the elements of the disease lie in the blood. In the absence of hereditary taint in children, the consumptive condition may be readily and effectually induced. Sir James Clarke observes, "Where this (the hereditary taint) does not

exist, the same disorders may be speedily induced in children of the healthiest parents, if they are exposed to the causes known to induce it. Whatever injures the health may lead to tuberculous cachexy; residence in a low, damp, and chilly situation; long confinement to close, ill-ventilated rooms, whether nurseries, school-rooms, or manufactories; deficient exercise in the open air; imperfect clothing; improper food, either deficient in quantity, or of innutritious quality; or the habitual use of over-stimulating diet, by inducing imperfect assimilation, may lead to tuberculous cachexy. The offspring of the healthiest parents may thus become tuberculous in early life, if exposed to the exciting causes enumerated. The earlier in life these causes are applied, the more rapidly in general will their effects be manifested."

In a considerable number of cases the causes of consumption are twofold, hereditary and acquired. The blood contains those elements which tend to tubercular deposits, while the conditions of life rapidly develop the changes which lead to their formation.

In any curative considerations, reference must be to the stage of the disease—whether primary or premonitory, and involving those conditions of the blood, and those states of congestion, which admit of amelioration and control, or that structural disorganisation which may be rapid, and admits of comparatively little relief.

In reflections on Malvern as a sanatorium for consumptives, and in suggestions for the hygienic and therapeutic treatment of this disease, reference will be chiefly made to the earlier premonitory and curable stages.

In a great number of cases *too much attention is paid to the lungs and too little to the state of the blood or general health.* In the very early stage—that which is strictly pre-tubercular—the blood remedies are essential to a cure. As elsewhere urged, these are mainly hygienic. Warmth, adequate clothing, pure

air, abundant sleep, good food, exposure to light and the sun's rays, and regulated exercise, are among the most important. These influences, it may be said, are simply preventive. As we shall shortly find, however, they are curative also. In consumptive cases where there is no actual lung deposit, the great object should be to improve the quality of the blood and to invigorate the vital power. This involves a double process. We must ensure the normal action of the organs of elimination, encourage a free exit from the blood of retained deleterious element, and regulate and energise the organs of nutrition so as to induce the formation of new and better blood. Medicines n the premonitory stage are ordinarily of little value. In some cases, however, iron is of service where the hæmatin of the blood is deficient. The red corpuscles also, as experience shows, develop under the administration of cod-liver oil. The hygienic remedies, it is essential to observe, to be effectual, require careful and medically directed supervision. The food—however important abundant nutritious diet may be—must be regulated in kind and quantity by the power of digestion; the amount of clothing must depend on the extent of animal warmth, and the susceptibleness of the body to climatic influences; the range of exercise must be strictly regulated at each time, and during the day, so as to invigorate but not exhaust the animal energies; these and numerous other agencies to be remedial must be systematised, and considered as essentials of rational treatment.

In these cases the gentle hydropathic processes exercise a marvellous and beneficial influence in regulating the action of the skin, equalising the circulation, preventing lung and other congestive action, by directing the blood into its right channels, by their influence on the organs of elimination, and by their almost invariable effect on the appetite and digestion.

Advance a step further. Conditions of congestion in the lungs exhibit themselves in various degrees. This stage of

disease is often difficult to detect, and not unfrequently advances undiscovered to a degree equally difficult to arrest or cure. If the system is predisposed to disease, and if the conditions of life are favourable to its development, the period of tubercular deposit arrives, and with it, of course, structural disorganisation. Much may be done even now in the way of arresting further mischief; but again it must be urged that the remedies lie, not in exclusive attention to the lungs and the employment of lung medicines, but in those agencies which will remove obstructions to functional action, and alter the condition of the blood.

The arrest of tubercular deposit, and the prolongation of life, is a matter of common experience. The success of hygienic treatment in the case of Dr Andrew Combe is well known. This celebrated writer on physiology was enabled to live many years in tolerable health with only one lung. Attention to the skin, diet, climate, and other hygienic influences, in large measure compensated for the loss of the other.

Climate, unquestionably, is a point of grave, if not essential importance, even in the primary or pre-tubercular stage. In this matter the professional mind has within the last few years undergone considerable change. A few years ago, a mild or warm climate was considered the main element in the arrest or cure of consumptive conditions. Exposure to cold and ordinary atmospheric influences was considered as dangerous. The invalid was compelled to breathe a vitiated atmosphere in a room of raised temperature, or as quickly as possible despatched to a warm and moist atmosphere by the seaside. Experience, however, demonstrates that cold is not a deadly or even injurious agent, provided it be not accompanied with damp, and that the invalid clothes himself with suitable apparel. Pure air and outdoor exercise, even in ungenial weather, are found to be more effective in arresting disease than close rooms and a warmer temperature.

In reference to a change to a warm climate, Sir James Clarke observes, "With the advocates of this measure, the state of the lungs appears to be the only consideration; but without improving the general health by exercise in the open air, all remedies directed to the local disease will be of little avail; the removal of the constitutional disorder can alone afford the patient a hope of recovery. In tuberculous cachexy, therefore, and even in incipient stages of consumption, particularly in young persons, I consider such a measure generally most unavoidable. But in advanced stages of consumption, when removal to a distant climate is worse than useless, life may be prolonged in many cases by keeping the invalid in apartments, the temperature of which is regulated and the air maintained in a pure state. Comparing then the benefits to consumptive patients likely to be derived from a mild climate, and confinement to rooms regulated to an agreeable temperature, there can be no question of the decided superiority of the former."

Dr J. R. Chambers observes, "If we inquire into the histories of those who have lived long with vomicæ or tubercles, they are by no means found to have taken special care of their chests—they have not coddled or lived in-doors in even temperatures, hanging their lives on to their thermometers for fear of coughs—they have gone on with their professions, or business, or work—they have not 'laid a knife to their throat,' but have eaten and drunk like other people, and have enjoyed the gratification of their appetites. A patient of mine, over fifty, with copious pyoptysis, and condensed lungs (of probably a tuberculous nature) from his youth, has kept hounds, broken his bones like other Nimrods, contested county elections, sat in parliament, enjoyed his champagne and other good things, but *never allows any doctoring of his chest.*" *

Dr Richardson, in illustration of some very judicious and

* "Lectures, chiefly Clinical," fourth edition, p. 271.

conclusive remarks on the same subject, states :—"I remember a patient once who, in the first stages of consumption, insisted on coming into town each morning from a considerable distance in the country, to look after his business, and to return home again in the afternoon. It mattered not that the sky looked threatening, for he was not afraid of such a trifle, although he knew that the plague-spot was in his breast. When expostulated with by friends, his reply was, 'My brothers and sisters have all died of consumption; they were coddled up, nursed, carried about, confined to bed, and bound in the cords of helplessness by the kindest hands, to the satisfaction of the doctor and of all concerned. But they soon died. I hold the germs of the same disease, and I too shall die, I know it; but my course is different, for I have made up my mind to die in harness; I have kept at my business in resistance to all entreaties; and I am the only one of the family left.' The plan adopted by this man was right; he bore the brunt of the disease for months, and to the best of my knowledge he is alive and occupied still."*

Rapid and severe transitions of temperature are to be avoided, under all circumstances, as far as practicable; but a limited and moderate range of temperature, and other atmospheric exposures, are not to be viewed as dangerous, or even injurious by consumptive patients. The most successful cases among this class of invalids whom I have had under treatment at Malvern, are those who have persevered in their daily walks in all conditions of the weather, however apparently adverse, and have day by day, as renewed health and strength permitted, ascended the hill-slopes, and given free play to their lungs.

Sir James Clarke, in confirmation of the hygienic treatment of consumption, remarks:—"By keeping up the habit of going daily into the open air, in almost all weather, under the protec-

* "On the Hygienic Treatment of Pulmonary Consumption." By B. W. Richardson, M.D. 1857.

tion of warm clothing, and with the addition of the respirator during the prevalence of cold winds, persons with very delicate lungs may bring themselves to bear this climate, and even strengthen their constitution to an extent not generally believed. If, in addition to this daily exposure to the open air for a longer or shorter period, according to the state of the weather, means were taken to secure a more uniform temperature, and an efficient ventilation in our houses, we should meet with much fewer examples of pulmonary and other diseases, generally attributed to the vicissitudes of our climate, but for which we are more indebted to the alternations of temperature created by ourselves, and the neglect of those precautions and means of defence which are within our power."

These and other facts lead us to the conclusion that a climate, even in consumptive cases, may be too equable, and consequently lacking those electric and other atmospheric changes which are essential conditions of a pure atmosphere. Dr Combe, whose case has already received notice, observed during his residence in Madeira, that invalids were in a better state of health during periods of atmospheric variation than when the weather was more than ordinarily equable and mild. Sir James Clarke makes a similar observation in remark to certain climatic resorts in England! "I have remarked," says this distinguished author, "the same effects resulting from long residence in some of the more sheltered spots of our island. Such situations form excellent residences for a time, after which the patient ceases to improve, and rather loses than gains strength. A long residence in a very mild and sheltered position I regard as unsuitable to young persons disposed to tubercular disease."

Next in importance to climate is *house ventilation*—the securing to consumptive invalids day and night rooms with abundant pure air. Every possible care should be taken to prevent the rebreathing of expired, and consequently pernicious air; and this can only be effected by means of rooms specially arranged for

ventilation, without exposure to draughts. The calculations of air breathed in the course of the day are startling, and exhibit in strong light the physiological importance of respiration. At a low estimate, one pair of lungs, in the course of a single hour, not merely subtracts from the atmosphere nearly 1500 cubic inches of oxygen—its vital constituent—but expires, and consequently vitiates, the air of a room by an equal number of carbonic acid, a deadly foe to animal life. Dr Richardson remarks that "in an atmosphere containing one per cent. of the carbonic acid of the breath, with the natural, but as yet undetermined, amount of ammonia evolved with the carbonic acid, in such an atmosphere a consumptive patient, though in the earliest stage of the disease, cannot possibly recover under any form of medical treatment; while in those pre-disposed to the disease, the inhalation of such an atmosphere, even at intervals, will aid materially in inducing the first symptoms of the disease."*

The invariable or essential condition of consumptive invalids is *diminished lung action, and consequently less inspiration of oxygen.* This exists even when there is no structural mischief, and in large measure doubtless depends on a lack of the vital stimulus —oxygen. An atmosphere pregnant with expired carbonic acid, must in a special sense be fatal in its influences on individuals whose feeble lung-action prevents the due inhalation of pure air. The absence of the one, and the presence of the other, are twofold influences which must, if continued, be disastrous, and call for the two essential pre-requisites to relief or cure—room ventilation and out-door exercise. Dr Richardson eloquently urges— "In the fields, on the hills, wherever the fresh air vivifies, where plants look most vigorous, and animals frisk about in the joy of health, there will the consumptive draw in his choicest medicine, there dissolve and throw off most freely the germs

* "On the Hygienic Treatment of Pulmonary Consumption," by Benj. W. Richardson, M.D., &c. 1857.

of his disease, and there repair most easily the tissues he has lost." *

A locality like that presented in Malvern, enables the medical practitioner to systematise the hygienic and other remedies for consumptives which cannot be combined in mere trips to ordinary watering-places, or be derived from a mere change of climate. In the treatment of any case, the point to consider is not merely atmospheric modifications, but other and various almost equally important essentials. How many phthisical patients benefit by a change of climate such as is experienced by a visit to the Nile or a sojourn at Algiers, but who suffer more than corresponding loss by the lack of good food and proper house accommodation. The exercise of tourists is often unsystematic and exhaustive. Persons of weak frames, by sight-seeing inspiration, are tempted to exposures which are essentially mischievous. In Egypt, long and exhaustive exposures to excessive heat; and in Italy, hours of exposure to the lightless and cold churches, with other ungenial atmospheric influences, have in numerous instances been sources of disease-development and death, rather than means of health-restoration and strength.

A well-regulated sanatorium for consumptive patients should include medical supervision day by day, in respect to diet, exercise, clothing, and other hygienic but really therapeutic essentials. To these, among other remedial agencies, should be added the additional means of increasing lung-action, which may be secured by gymnastic exercises. These exercises may be varied in their mode of application. The muscles of respiration, by which the movements of the chest are effected, may from day to day be gently roused to more vigorous action. By an equally graduated process, the air cells may, without fear of injurious consequences, be induced to receive a larger amount of air, and the whole process of blood regeneration derive a healthy impulse—*the*

* *Ibid.*

impulse necessary to arrest disease in its earlier and incipient stage.

One or two physiological facts demonstrate the importance of developing the function of the air cells. These cells are distinct membranous sacs, possessing an exquisitely fine structure, through which air passes into and out of the blood. It is computed that their number in the lungs of one individual is not less than 500,000,000. Like every other organ or portion of the body, they may be weak and limited in their action, or capacious and strong, and this capacity and strength will largely depend on exercise. Lung action, like all other animal functions, may become weak by want of exercise; hence the physician, while he primarily directs his attention to the organs of nutrition, does not omit at the same time to secure what Arbuthnot correctly terms "the second digestion"—proper respiration. Abundance of pure air is essential not only to a good appetite, but to good digestion, and is certainly indispensable to the formation of good blood.

However beneficial movements of the chest induced by mechanical contrivances, more important still is the benefit to be derived from voluntary deep inspirations. A little instruction and practice soon enables the patient to acquire the habit of taking inspirations in such a way as readily at each breath to double and even treble the ordinary amount of air, and this without any unpleasant or unsafe expansion of the air vesicles. It is important also to note, that with increase of respiration there is corresponding evolution of carbonic acid.

It has already been stated, that the exercise of consumptive invalids should be regulated and carefully proportioned to the strength of the patient. Where there is manifest weakness, and in particular where there is a tendency to hæmorrhage, violent or exhaustive exercises of every kind should be avoided. The patient, however, should be in the open air nearly all the day, but he should always restrict his exercise within the limits of

fatigue. In some cases horse exercise may be the best, in others carriage drives, but in a great majority of instances walking is most conducive to health. The experiments and conclusions of Dr Edward Smith will tend to some practical considerations of this subject. The conveyance of weights, at three miles per hour, increases the quantity of air inspired per minute at the rate of $7\frac{1}{2}$ cubic inches for every pound weight carried. Bowling, throwing of weights, climbing, wrestling, running, jumping, and dancing, all increase the quantity of air inspired from double to seven times the original quantity, and in a proportionate degree the depth of inspiration. In reference to the quantity of air inspired, one hour of walking, at the rate of three miles per hour, would be equal to more than three hours of quiet sitting. Half-an-hour of running, at six miles per hour, would fully equal the same quantity. One hour of riding in an omnibus or carriage, if not of easy construction, is equal to about one hour and three-quarters in the sitting posture. One hour of riding on horseback, at a walking pace, ensures the inspiration of as much air as will be breathed by an individual in the sitting posture in one hour and three-quarters; at a canter, the inspiration is increased threefold; and at a rough trot three times and a-half." *

Dr Smith informs us, that in experiments made upon himself, he proved that walking in health at one mile per hour increases the respiration from 500 cubic inches to 800 cubic inches per minute; at two miles per hour, to 1000 cubic inches; at three miles per hour, to 1600 inches; and at four miles per hour, 2300 cubic inches per minute. Whilst running moderately, at six miles per hour, it reaches more than 3000 cubic inches per minute. Dr Smith also found that the depth of inspiration was likewise increased from 35 cubic inches to 100 cubic inches per respiration. Thus exercise greatly increases both the mechanical distension of the lungs and the chemical and physical changes of inspiration.†

* "The Principles of Treatment in Chronic Phthisis," by Ed. Smith, M.D., p. 45. 1858.

† *Ibid.*, p. 45.

These facts demonstrate the importance of out-door exercise to consumptives, and point to those auxiliary aids to lung action, and consequently blood purification, which are as easy of application as they are beneficial in effect.

Clothing, sleep, and diet, in connection with the hygienic treatment of consumptive patients, require brief consideration.

The object of clothing should be to maintain an equalised normal temperature. The true source of animal heat is from within. The body manufactures the heat it requires by its own mechanism. All attempts to induce permanent warmth from external agencies will be fruitless. Food rich in carbon, healthily digested, with an abundant supply of oxygen to burn it, is the only effectual mode of keeping up the animal fire. The calorifient process, therefore, is dependent on an appropriate supply of food, the state of digestion, and healthy respiration. The aim of clothing should be, in all changes of season or weather, to preserve the same normal temperature. In a bloodless, low, vital condition, the body of course is susceptible of chills, and in consumptive tendencies there is fear of lung congestion. In such cases the clothing should be adequate to maintain equable bodily warmth, but in no case to form a substitute for exercise. It should be abundant, but judiciously light, not pressing upon or encumbering any portion of the body, but permitting in every part free muscular exercise. To attempt to harden the system in every case, and under every circumstance, by light clothing, is a physical crime, and physiologically unattainable. No absolute rule, therefore, can be given as to clothing, except that its object is to preserve an equalised normal temperature, and therefore must vary in different seasons of the year, and according to the state of the weather. In addition to these physiological conditions of animal heat, it may be added, that no plan better conduces to promote equable bodily warmth than vigorous action of the skin ; and this, as elsewhere noticed, is largely aided by judicious ablutions and cutaneous friction.

Whatever difference of opinion may exist in reference to quality of material and thickness in dress, none can be entertained as to the suicidal influence in females of diminishing the capacity of the chest by corsets and other constraining appendages. On this point medical opinion and experience is absolute and conclusive. A volume might be filled with cases in illustration. Only one is now given, by way of practical enforcement. A lady visited me, some years ago, for consultation, labouring under serious difficulty of breathing, and evident impending lung mischief. When her attention was drawn to the danger of constricting the movements of the chest by corsets, she earnestly declared that throughout life she had never accustomed herself to "tight lacing." The spirometer was introduced, and the lady, by careful experiment, ascertained the extent of her breathing power. She was then requested to retire into an adjoining room, and to remove her corset. This accomplished, she again breathed under the test of the spirometer, and the lungs were found to contain exactly double the amount of air when unembarrassed by artificial restraint.

Absolute freedom of the chest, with every hindrance to its uniform exercise removed, must be considered, then, as essential in the hygienic treatment of consumptives, and enforced as the basis of a successful plan of relief or cure.

Sleep by night is as important to the consumptive as exercise by day. Although we may not agree with Menander that sleep is "a remedy for every curable disease," yet we may admit with Shakespere that it is the "chief nourisher in life's feast." Metcalfe defines the difference between exercise and sleep, "that during exercise the expenditure of the body exceeds the income; whereas during sleep the income of the body exceeds the expenditure."

In consumptive patients there is manifest lack of muscular power and animal warmth. Hence the rest and warmth of bed prevents more or less waste of tissue and abstraction of heat.

Thus far the income exceeds the expenditure. This gain, however, presupposes sleep under healthy conditions. The bed arrangements should be suitable, and the ventilation of the room effectual. Expired air under any circumstances is poisonous, but the breath exhaled from the lungs of consumptive patients, and the skin exhalations also, are peculiarly offensive. Fires, artificial light, and other causes of air deterioration, should be avoided, except in rooms of large size, or which have special means of ventilation. "Whenever a man," observes Dr Richardson, "shuts himself up in his closet, and makes a little sun out of his gas lamp or candle, he is feeding that lamp with a part of his own breathing store—the air around him. Worse still, the candle can, no more than the man, live a light without exhaling carbonic acid gas, and thus vitiating the atmosphere." On various grounds early rest is important. Early to bed and early to rise is a sound maxim, and founded on physiological truth. Sleep at this period is most refreshing, while the adverse influences of hot rooms and artificial light are avoided.

During sleep the action of the organic nervous influence is increased, but the cerebral and sensorial functions are in arrest. The number of respirations is diminished, and consequently the inspiration of oxygen and expiration of carbonic acid. The action of the heart is lessened, and the circulation is of course more feeble. There is less pressure on the heart, and probably a more equable distribution of the blood. Hence in feeble persons the repair of waste by the formation of tissue goes on under more favourable circumstances.

DIET

Forms an important element in the hygienic treatment of phthisical patients. No code of absolute rule can be laid down for dietetic observance. The physician has to regulate the diet of each patient, and in each patient usually there exists some peculiarity which must modify more or less the quality and quantity of food.

The desire for food depends much on exercise. Exercise, however, must be kept within due limits, or it may induce too great waste of tissue and consequent necessity for nutriment. If the appetite and state of digestion are not adequate to supply the demand, the loss of the system may be serious. This fact shows the importance in consumptive patients of rectifying and strengthening the digestive functions. It is worse than useless to cram patients with food, however nutritious, which the stomach cannot digest. The quantity of food, therefore, at each meal should be proportioned to the power of digestion. In consumptive cases in particular, the stomach should not be loaded, because any distension of this organ diminishes the expansion of the lungs, and consequently interferes with free respiration. Hence light but frequent meals are more congenial. During the night the vital actions are lessened, the respirations are fewer in number than by day, the pulsations also are diminished, and in early morning the patient can bear without inconvenience a supply of nutritious food, in particular, if there should be a tendency to perspiration with its exhaustive influence.

The special medical treatment in cases of consumption requires some consideration, even in a popular treatise like the present. No specific medicines are available for those conditions of the blood which form the basis of this wide-spread malady—wide-spread, indeed, when it is known in London and in Paris to be 1 in 5 of the diseases of adults recorded in the vast populations of these cities.

Consumption is not necessarily a disorder of the English climate. It is a disease dependent on removable or preventible causes in connection with climate. There exists no reason why, to a very large extent, this formidable malady should not cease to exist, or be reduced to a proportion less likely to bring discredit on a relatively healthy climate and learned profession.

GENERAL DEBILITY

Is the condition to which medical attention should be first directed. Tonics are oftentimes exceedingly beneficial, especially when administered in the form of food-medicines, such as iron, cod-liver oil, cream, &c. In most cases articles of food rich in carbon, such as oil and cream, are not merely relished by the patient, but rapidly induce warmth and strength. The free production of the red corpuscles after the administration of cod-liver oil is an important fact, and shows that the action of that well-known remedy is not merely calorifient. The administration also of iron is often attended with remarkable results, and in those cases in particular, where from lack of appetite and digestive power, the patient is unable to eat and digest those ordinary articles of food which are rich in this essential constituent of the blood. Quinine also is a valuable medicine, and may with advantage be united with iron. Tonic medicines, however, should not be given until any disorder of the stomach and liver shall have been removed.

COUGH

In various forms constitutes a symptom of solicitude both to the patient and medical attendant. It is not unfrequently a perplexing symptom, dependent on sympathetic and removable causes, and not a sign of structural derangement. Derangement of the stomach is not uncommonly the cause of a cough, and the troublesome symptom, therefore, can only be removed by attention to that organ—ordinary cough applications are in such cases worse than useless.

Bad air is a common source of cough irritation. It not merely acts as an irritant on the air passages, but disturbs the pulmonary circulation, and induces temporary lung congestion, with cough and expectoration. Hence the essential element of good ventilation in parlours and bedrooms.

Dr Richardson adduces a practical illustration of the influence of breathing in a dry and confined atmosphere. A gentleman whose lungs were free from tubercle and other organic disorders, was constantly annoyed and troubled with slight attacks of barking cough and blood-spitting. After some reflection, he discovered that the attack always commenced when he was at work in his study. This room, which was small, was made very warm and comfortable by a stove. To a stranger the heat and dryness of the atmosphere were oppressive; to its constant occupant custom rendered it agreeable, but the chest had to suffer the penalty. The cause of the symptoms being explained, the stove was abandoned, and without the aid of medicine the cough and blood-spitting at once disappeared. After a few weeks, the patient thinking that the stove and the cough only stood in the relation of coincidences, the use of the stove was resumed, and the cough and blood-spitting again made their appearance. Cause and effect were now seen and acknowledged, and the cause removed, the patient has been well ever since.

IRRITABLE OR IRREGULAR ACTION OF THE HEART

Is a common symptom, and often dependent on general debility. The heart in fact flutters for want of blood—not merely blood in sufficient quantity, but blood sufficiently pure to stimulate it to healthy action. A confined and vitiated atmosphere will also bring on irregular action of the heart by its disturbance of the pulmonic circulation.

DYSPNŒA,

Or difficulty of breathing, is a symptom which naturally excites alarm, and rightly so if it is indicative of congestion or other morbid condition of the lungs. Deficient breathing, however, often arises from general weakness, from debility of the air cells where there is no disease, from breathing an improper atmosphere, from derangement of the digestive apparatus, and from other

similar causes. These are points, of course, to which the medical man directs careful attention, and in many cases the causes are removable, or, at all events, mainly hygienic remedies suffice to afford material relief.

FREE PERSPIRATION, NIGHT SWEATS,

Are indications of physical weakness, and of weakness at particular times, and by care may be prevented or removed, or, at all events, largely mitigated. This amelioration or prevention depends on a proper amount of bed-clothing, on the thorough ventilation of the room, and therefore free action of the lungs; on the amount of liquid food, on proper attention to the skin, and in an especial sense on every remedial agency which can restore functional action, and build up the general strength.

In the consideration of remedial agencies in consumption, in connection with its hygienic treatment, it is desirable to record the eminently beneficial influences of water applications. During an experience of some thirty years in hydro-therapeutic practice, I have witnessed effects, from the judicious administration of baths in cases where medicines have failed, the most encouraging and successful.

Let us bear in mind, in explanation of this subject, that the skin and lungs are organs performing analogous functions. They are both organs of elimination separating from the blood the same effete elements. The lungs absorb into the blood oxygen from the atmosphere. In a more limited sense, it is probable that the skin performs a similar function. Numerous facts show to us the sympathy which exists between the skin and the lungs. If in comparative health skin action be neglected, a greater amount of labour is thrown upon the lungs. In pulmonary affections, if the lungs should labour under congestion, no more sure means of relief exist than by acting on the skin. The influence to ordinary vision seems magical—to the medical mind it is apparent on grounds of physiological action. It is only in

medical practice adopting the invariable instinct of nature, who endeavours in cases of overloaded and oppressed organs to relieve them in their struggle for life, by inducing other and analogous organs to take upon themselves, for the time being, a larger than ordinary share of labour.

The effects of the water applications, combined with genial frictions on the skin, in inducing capillary action, and in equalising the circulation of the blood, are remarkable. In this way more uniform warmth is readily accomplished. The mustard and other foot baths produce great relief by securing free circulation in the extremities. The mustard and various chest packs, and fomentations, have a strong influence in relieving pulmonary congestion. The abdominal pack or compress applications, and fomentations, exercise a salutary influence on the digestive apparatus, and the impulse given to the whole animal economy by other wisely administered baths, is such as to demand from the medical profession a fair trial of their therapeutic action.

One great advantage of hydro-therapeutic remedies arises from the fact that they can be successfully employed in a vast number of those cases where the stomach rejects ordinary and valuable medical prescriptions. The stomach too often is an over-worked and over-physicked organ, while the skin is too frequently neglected and practically treated as exercising little influence in the animal economy. It seems literally to rejoice under the action of genial washing, and the functional vigour which ensues is proof, in this case at least, that sensation and benefit go hand in hand.

XVIII.—On the Selection of Climate.

The adaptation of climate to disease is often a difficult point to determine. Theory, very frequently, is at fault, and experience, in individual cases, runs counter to theoretical conclusions. It is remarkable how in two cases, apparently similar in condition,

the influence of special climate varies. Doubtless there are occult pathological conditions which, if known, would to some extent account for this difference. So much also depends on temperament in association with disease, and consequently expression of feeling. Again, some exceptional condition of the weather may influence the feelings of a temporary visitor. An invalid visits a watering-place at a particular season—when the heat is oppressive everywhere, or there is a general fall of rain throughout the kingdom. This recollection of that particular locality is one of either extreme heat or constant rain. The therapeutic value of any health-resort must be determined by its average meteorological conditions during certain months, or during the whole year, and not by exceptional phenomena or mere temporary experience. Dr Charles J. B. Williams, in a valuable series of papers, entitled, "Notes on Alpine Summer Quarters for Invalids," gives some amusing and instructive illustrations of the influence of variations of climate in his own case. "Leaving town," he observes, "in the extreme heat of the August of 1868, we found Penzance and the Land's End so cold and damp that toothache drove me back to London for the aid of the dentist; and although a second visit to Devonshire supplied abundant objects of interest and occupation, yet the keen air of Dartmoor brought on a severe attack of eczema solare, which I had never had before, even after any amount of exposure to the sun and air of snow mountains and glaciers in Switzerland."* Away starts Dr Williams on an Alpine excursion, and at the Victoria station a well-known *confrère*, whom he accidentally met, exclaimed, "To the Engadine, I suppose, like every one else." On the road he found that the greater number of English travellers were wending their steps to the same place, to partake of the marvellous improvement experienced on a change from London to a high Swiss valley. The worst of it, however, was that they could scarcely get enough to eat, and one of the doctor's fellow-

* *British Medical Journal*, 1869, p. 551.

travellers had wisely provided for this want by taking with him a *live turtle*, which, at all events, formed an object of great curiosity to the railway officials, and others who had never before seen such an animal. A previous visit of Dr Williams to the Engadine had not excited any very enthusiastic feeling in reference to its climate. After some limited pleasant experience, "But then came a change to what is proverbially said to be the more common weather of the Engadine in summer. First came rain; next day snow; and at night frost, *and this in the month of August.* As there was no inducement to make excursions into snow and cloud (except for a few minutes to keep ourselves warm), the disappointed travellers were shut up, miserable enough, in the *salle d manger.* An attempt was made to light the stove, but it ended in smoke, of which we had already too much from the unrestrained devotees of the pernicious weed. The provisions ran short, and the viands of the table d'hôte were little more than *bouilli et compôte de pruneaux.* So feeling somewhat in danger of double starvation, and not being disposed to prolong this experiment of hybernation in a summer month," Dr Williams ordered a carriage to take him out of "these winter quarters," and betook himself to the more genial districts of Vicosoprano and Lake Como, exclaiming, in his delight at the change, "Oh how we pitied those still remaining in that arctic region!" *

Dr T. H. Chambers, in his work, "Some Effects of the Climate of Italy," adduces some interesting facts as to the climate of that country, and appends some important warnings to seekers after health. The ordinary guide-books are very uncertain advisers, and the statistics they give are frequently incorrect. Doubtless a residence in a genial continental climate has in many cases arrested disease, and in others saved life, but a proper selection of climate in each case is an essential pre-requisite, united as it must be with a proper use of it. The sun in Italy

* *British Medical Journal*, 1869, p. 551.

sends forth its cheering rays in profuse abundance, but the houses are built rather to exclude the heat of summer than to encourage its healing influence in winter. The antique and gloomy churches, and sombre galleries of paintings, are not places favourable to consumptive or asthmatic invalids. In numerous celebrated health-resorts the malaria of the district and the dew of night will, on a single exposure, do more harm than any good that may be experienced by a long residence in a more genial atmosphere. "Even in summer," Dr Chambers correctly remarks, "sun*light* is of value, though sun*shine* in the middle of the day is too powerful."

The word *comfort* is an English phrase, and to English invalids one of no slight importance. It is often an essential element in the cure. Good houses and good food are as necessary to health-restoration as good air. The discomforts of continental life, to a large class of invalids, more than counterbalance any benefit derived from change of climate. A lady, a patient of the author's, subject to severe bronchial attacks, went under sanguine expectations to winter at Algiers, but the house accommodation she got was so draughty as to render nugatory any beneficial effect of climate. The invalid returned home worse than she went. Numerous similar cases are of common occurrence. Dr Chambers gives a humorous account of an annoyance experienced by travellers in Italy. "The beds in Italy are generally very good. The elegant iron and brass framework manufactured at Genoa is the neatest and cleanest bedstead that can be devised. The bolsters and mattresses are very light and moveable, and even in Capuchin convents are usually shaken out of window daily. But alas! all this care does not exclude fleas. Wherever man is, be it in a hovel on a desert mountain, inhabited perhaps once a month, be it in an excavation at Pompeii, or in a Greek theatre, where no one has sat for more than 2000 years, there is his agile tyrant, so that it is not to be expected that the bedrooms should be free. I say this in mere

justice, to try and save Maritornes an unmerited scolding, when the unhardened traveller has found himself present at a nocturnal feast, 'not where he eats, but where he is eaten.' He had better console himself with the popular Italian dictum that such punctures are wholesome in moderation. If he cannot attain to such philosophy, authorities recommend his taking a calico sleeping-bag to a country inn. So far so good—but before he starts let him try one night in it to see that it is long and wide enough. If too small, repose there is as difficult as in a Venetian dungeon (*probatum est*), and the materials for a new one are unattainable in provincial shops" (p. 91).

The necessity of a selection of cases, as well as a selection of climate, is essential. The benefit to be gained may altogether depend on the strength of the patient and the stage of the complaint. It would be the extreme of folly to send an invalid suffering from *active* disease to an alpine climate like that described by Dr Williams, with its rain, and snow, and frost, even in the month of August, and with insufficient house accommodation; while, to others, the exhaustive heat of Egypt would be equally fatal to the vital energies. What is life to one would be death to another. The following example is adduced in illustration. It is extracted from a very interesting work by the Rev. Alfred Charles Smith, M.A., entitled, "The Attractions of the Nile and its Banks." During his voyage up the Nile, with every precaution to induce coolness, the maximum often rose to 95° and 97°, while on the deck it ran up to 141°, and then he was obliged to remove the instrument for fear of accident, as the quicksilver filled the entire tube." Mr Smith adds, "Different constitutions are differently affected by extreme heat, and in this respect one man's meat is another man's poison; for while I daily grew stronger and hardier as the thermometer rose, and revelled in the intense sunshine, even spending many hours of almost every day in the desert, toiling through the heavy sand with my gun, with only a muslin turban wound round my

hat to protect my head from the fierce rays of the tropical sun, my companion H., though he did not attempt to leave the boat, became weaker and weaker as the heat increased, his strength seemed altogether ebbing away, and he could scarcely crawl on deck and lie under the awning, and we were quite frightened at the utter prostration of energy from which he suffered; and it was not until we returned to Lower Egypt, and the days became cooler, and the nights almost cold, that he revived from that extreme lassitude, and regained strength with the fresh invigorating breezes from the north. To myself, individually, the climate of Egypt has been, under Providence, of the greatest value." *

Many comparatively delicate invalids almost walk themselves to death. They forget that a visit to Egypt or an alpine sojourn is intended to afford climatic relief to the ravages of disease, or to stimulate to healthy action exhausted nature. Sight-seeing is interesting to the mind, but wearying to the body. The powers of nature in the invalid should not be overtasked, but nursed and strengthened. Oppressed organs, by exposure to a more genial air, may obtain much relief; but the benefit derived may be more than counterbalanced by the depressing influence of over-exercise.

In the choice of a climate we must not always depend on statistical evidence. Yet statistics do much to assist us in arriving at a correct decision. The predisposition to certain diseases induced by climate is remarkable. At Milan there were admitted into the Hospitale Maggiore, in three years, 464 cases of hepatitis, or inflammation of the liver, or 1 in 133 in proportion to the number of cases admitted; while at St Mary's Hospital, London, in nine years, the number of cases of the same diseases was only 9, or 1 in proportion to 813.

The registered number of cases of *deaths* under the head "acute

* "The Attractions of the Nile and its Banks," vol. ii. p. 177.

affections of respiratory organs," or "laryngitis," "pleurisy," and "pneumonia," are—in Genoa, 450, or 1 in 9; in London, 4021, or 1 in 16. At the Milan Hospital, the hospital patients suffering from pneumonia and pleurisy were 1 in 12; but at St Mary's Hospital, 1 in 22. Dr Chambers observes, "It is clear, therefore, that the old idea of avoiding inflammation by sending patients to Italy is a fallacious one, for the prevalence of inflammation of the lungs is, by the above numbers, nearly twice as great as it is in England."* Febrile bronchitis, a disease closely allied to pneumonia, comes under the same category; 5668 cases of febrile bronchitis, including influenza and acute catarrh, were admitted into the Milan Hospital, or 1 in 10, while the similar cases admitted into St Mary's Hospital, London, did not exceed 245, or 1 in 29.

The difference, however, in the existence of *chronic* bronchitis in Italy and London is remarkable. The cases of "*chronic bronchitis*," or "*bronchorrea*," admitted at St Mary's, London, were 224, or 1 in 32; at Milan, only 7, or 1 in 8823.

The total number of acute diseases tabulated at Milan amount to 31,950, or 1 in 1·9; at St Mary's, to 2293, or only 1 in 3·2.

In a comparison of acute and chronic affections of the respiratory organs, as given above, we find that the number of *chronic* cases of disease in London is largely in excess. The tendency of this form of disease to pass "into a chronic degenerative stage," is a point of much importance to the physician. To detect the particular stage of disease, to ward off any morbid deposits, to arrest any onward degenerative process, by a change of climate or any other hygienic prescription, these are points on which the future of the patient may depend; but in the exercise of this advice, special experience and judgment are required.

Recognising the vital power as the great agent in the relief or cure of disease, regard must be had to a variety of circumstances.

* "On the Climate of Italy," p. 42.

Change of air is a powerful remedy. It often enables an invalid to be out all the day in a genial climate, while he would remain comparatively a house-prisoner at home. The sunny climate of Italy or Egypt, to a class of invalids, is an earthly paradise compared with the colder and foggier atmosphere of England. It must not, however, be overlooked, that these warm climates predispose to morbid conditions rapidly fatal to life, and are unsuited to specific stages of disease. What a patient desires is to derive the greatest amount of benefit in his particular case, not from one, but from combined influences. Good food and good house accommodation are often as potential in their effects as good air. What he gains in one respect he may lose in another. On this ground experience often shows that a change to a foreign climate is not always a change for the better, inasmuch as it involves sacrifices of comforts and necessities for which a purer and brighter atmosphere does not always adequately compensate.

In reference to alpine selection, Dr Williams judiciously observes, that other points besides altitude require consideration. "What absolute height," he remarks, "whether at 6000 or 5000 feet above the level of the sea, may be best, is yet to be determined by experience; but there can be little doubt that *shelter from the coldest winds, an aspect favourable to receive all the sunshine obtainable in the winter, a dry unswampy soil, and a comfortable house*, with well-regulated stoves to warm, and a well-supplied larder to feed, the winter inmates, will be essential to their well-doing."—*British Medical Journal*, 1869, p. 577.

A recent article in the *Pall Mall Gazette*,* entitled "Winters in the South," enlarges very judiciously on the subject of the selection of a winter climate for invalids—"Climate and an equable temperature." The writer observes—"To the minds of the untravelled, and, to judge by the orders they give, of most

* *Pall Mall Gazette*, 5th February 1870.

doctors, the South is a spell to conjure back health and scare disease; its air healthiest—anywhere, or anyhow—a sort of atmospheric Bethesda infallible to cure. It does not take a modern Hippocrates to tell you that one sort of atmosphere must be better than another for diseased lungs; although the laity may well stand staggered between the theories that prescribe the snows of the Alps and the sands of the Desert. But what you do want is what you so seldom find—a scientific analysis of the relative value of different climates, or at least its results embodied in the prescription you pay for. With regard to that, our stay-at-home doctors, who seldom give themselves a winter holiday, move along dozily in the old grooves, and preach the antiquated traditions. If you appeal to them pointblank for special directions, they name some familiar name; but when you ask why the place that bears it should be specially beneficial to your particular case, they can give nothing but the vaguest reasons for the faith that is in them. The medical men who do know the South, and reside there, have, generally speaking, limited their experiences to a single district, each swearing through thick and thin by the place he has selected to live by; and you hesitate naturally about consulting evidently interested witnesses. They may be honest; but they are probably ill-informed, and almost assuredly prejudiced. Talking of that same luck in life we alluded to in setting out, it is extraordinary how much it does for towns as well as people. What else has given Nice its hold on the fancies of invalids and their doctors, and filled its hotels and cemeteries? One instant you are sweltering in the sun, the next the cold gusts whistling down through the snowy Alps are cutting you like razor-blades. If you turn out for the short strolls that are within the compass of an invalid's weakness, you have to beat the city flags, or struggle up-hill between cold damp vineyard walls. As for Cannes, so rapidly becoming fashionable, opinions are mere matters of taste, although there are far more attractive places in the Cornice, and

its thriving native population have every reason to bless the memory of Lord Brougham. And what shall we say of Mentone, except that it has a lovely variety of walks, simmering in the corner of its hot bay, sapping the strength even of invalids, and wrecking the constitutions of the healthy? while San Remo, farther on, with an air at once soft and bracing, is only slowly struggling into name by sheer force of merit."

After some additional remarks on various places of health-resorts in Spain and in the Mediterranean isles, the writer adds —"At present, the invalid making up his mind at the critical point of his disease, puts his hand into a lottery. He may draw a prize, and pass a placid winter, body and mind, and come home cured; or he may spend a fatal one in an unsuitable climate, paid for at a ruinous expense."

The trials and privations of a journey to reach some favourable spot are next dilated on, and the remark follows, that "there ought to be tonic and balm in southern air, indeed, to counterbalance the consequences of certainties and risks like these."

The conclusion of the clever article is too sensible and graphic not to be given:—"But, finally, the chief feature of all in your arrangements is absolutely beyond your own control or your doctor's prevision. You may have a 'good' winter or a bad one, like this. In the event of the latter unlucky contingency, it must be said the better established winter-quarters have a distinct advantage, inasmuch as their houses are generally built with an eye to English wants, and consequently better provided with fire-places. But, after all, this is merely a question of degree. The very best southern houses would be pronounced exquisitely uncomfortable in a cold climate; their most substantial architecture, massive as the old walls may sometimes be, is as ill-secured against the elements as the terraces run up by insolvent builders in our poorer suburbs. A very moderate cold in the South lands you between two stools: you have left solid walls, tight-fitting

window sashes, and blazing Wallsend fires behind you, and you have come in for cloud and storm instead of the calm and sunshine you fondly dreamed of. You cower over a wood-fire, sputtering with damp logs, hard to light, continually going out, and impossible to fan into a permanent blaze. If your circle is a large one, some of its members must freeze, for the only way of warming oneself is literally to do as the Scotch say, and 'sit into the fire;' and then, after all, you are only overdone on one side, while the other feels all the colder. You have from three doors to half-a-dozen in your sitting-room, according to its size, and the winds whistling under them from all points of the compass meet to play in the middle, and roll up into a ball the patch of carpet from the cold tile-floor. The breezes that come in by the doors go out by the windows, which rattle like castanets out of time. The feeling of dismal desolation that strikes to your heart, with its accompanying material chill, when you retire to your fireless bedroom, is only to be surpassed by that with which you awake to the long miseries of a new day, look out on the rain and sleet beating on your window-panes and trickling in on your floor, and regard ruefully your once-loved bath. Invalid as you are, you are deprived at once of the means of procuring yourself natural or artificial heat. You shiver in piles of clothes, while, like an arctic voyager, your skin crackles and your hair frizzles with the constant cold. You are cut off from the mental resources that would have cheered and occupied you in your comfortable home in England. The snow has stopped the posts somewhere—at any rate, your papers have not come to hand. You have finished the lighter literature you brought with you: you turn away sickening, in your morbid state of mind, from the slow solid reading you brought to fall back upon; you are reduced to odd volumes of the rubbish shot out three years before from English provincial circulating libraries. By and by, in spring, the sky may clear, the sun may shine out as if nothing had happened, or asking you to let bygones be bygones. But it

is too late. What man, trembling on the brink of grave disease, but must be precipitated into it by the treatment you have been subjected to? The doctor and you may apportion the blame between you, or you may call it luck, or blaspheme Providence. What is certain is, you have succeeded in sowing the seeds of something that will make a far stronger case for a change next year."

The Registrar-General in one of his quarterly returns observes, "*It is well established that England is the healthiest country in Europe.* France stands next to England in salubrity. In the continental cities the annual rate of mortality is seldom less than 30 in 1000, and the rate frequently rises to 40 in 1000. In London the annual rate of mortality is 25 in 1000." The *Times* for July of the same year, in commenting on this report remarks, "Now, on the strength of the Registrar-General's report, we may be allowed to put in a plea in favour of home. We do not say there is no place like it, but still the conduct of our countrymen of late years has been as if their own land was a prison, from which a natural instinct prompts a flight at the first moment of liberty. The usual argument is that health demands a change of air, and therefore a foreign clime must be visited. Now, it is proved that England 'crowned with hills of moderate elevation, sloping towards the east and south,' 'bathed by the showers of the Atlantic,'—though we will not lay much stress on this peculiar attraction,—'cultivated more extensively than other lands, and producing those unequalled breeds of animals which flourish only in healthy places,' enjoys a salubrity beyond any of those countries to which the flight of English pleasure-seekers is directed. Why not, then, recur to the habits of the old times, and travel about England, of which some of our countrymen know much less than of the Rhine, the Danube, and the Tagus?" "Families who would be much more comfortable and happy in their own island, think it necessary to follow the general example, and the mania for annual travelling is communicated from one

to another, until it has become almost part of the nature of the people."

The opinion of the Registrar-General is corroborated in the opinion and experience of the eminent American author Nathaniel Hawthorne, who asserts that "notwithstanding its mists and fog, and many drawbacks, the climate of England is the best in the world."

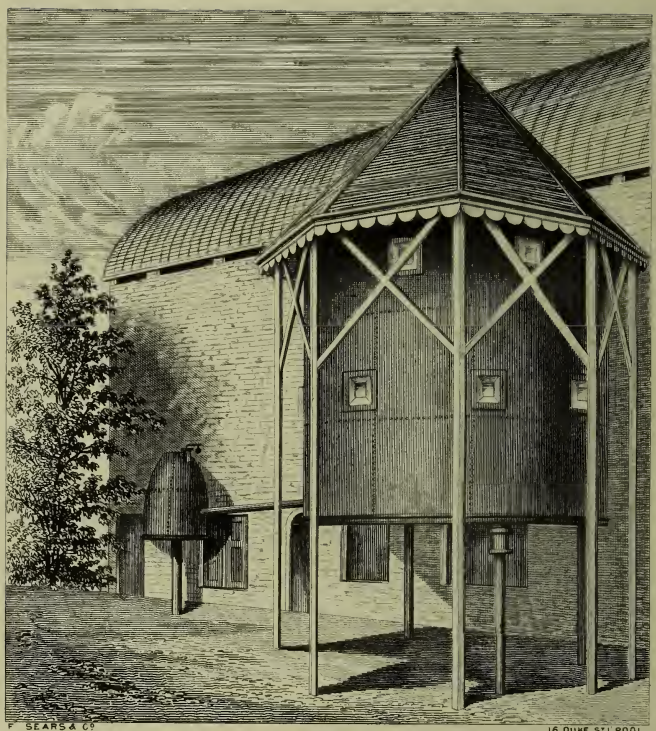
Sir James Clarke, in his work on climate, very justly remarks, that "the man of science knows that there exists scarcely a single remedy for any disease which can warrant the boast [that there is a specific for any or for all diseases], and that it is only by acting on and through the numerous and complicated functions of the living body in various ways, and by various means, and by carefully adapting our treatment to the circumstances of each individual case, that we can remove or check the disorders of the animal system, more especially those which have long existed." He continues, "Let it not then be imagined that a change of climate, however powerful as a remedy, can be considered at all peculiar in its modes of action, or as justifying, on the part of the physician or the patient, the neglect of those precautions which are requisite to ensure the proper action of other remedies. Had I not considered *climate* as a remedial agent of great value, and deserving the attention of medical men, the present work would not have been undertaken; but I feel that I should be at once compromising the dignity and honour of my profession, and acting in direct opposition to the dictates of experience, if I admitted for a moment that it is one possessing *specific powers*, or which may be indiscriminately employed without regard to the general fundamental principles of medical science."

XIX.—On the Physiological and Therapeutic Influence of Compressed Air.

The therapeutic influence of compressed air deserves careful medical consideration. There are certain forms of disease, or special cases of these forms, which hitherto have baffled medical skill, and which fail to obtain relief or cure by the use of ordinary remedies. Some of these have unquestionably received benefit or cure by the action of compressed air. How was the remedy first suggested and brought into use? What is its mode of administration, and what are its therapeutic effects? In what forms of disease has its success been more or less tested, and what conclusions may be drawn as to its future and extended application? These are points of consideration, in any remedial system, of primary importance both to the patient and physician. Let the severest test be applied to the investigation.

The ordinary atmospheric pressure is 14 lbs. to the square inch. Every one, however, is familiar with the fact, how a difference in height influences the feelings, and to a greater or less extent the action of respiration. This fact led to the presumption that an alteration of atmospheric pressure might have special therapeutic or medical influences, and induced various parties to institute experiments which have already eventuated in important and decisive results. These results, it is proper to mention, have been arrived at after long continued and careful observation, and severe test by men of science and legitimate members of the profession. From time to time communications have been made on the subject to various medical and scientific societies, and essays and volumes have been issued containing the results of experience on a scale and to an extent which at all events demand careful and unprejudiced consideration.

In the present necessarily brief exposition, an outline sketch



Exterior of Compressed Air Chamber.

only will be given of the invention of the bath—its construction and mode of administration, its physiological effects, and its influence in disease.

1. HISTORICAL SKETCH.

Suggestions for the erection of a domicilium, or air chamber, with regulated pressure, were made so early as 1664, by Dr Henshaw, an English physician. The merit, however, of reducing the application of compressed air as a therapeutic agent to a system, is due to M. Emile Tabarié, who, after lengthened experiments, arrived at a series of practical conclusions which, in 1832, he communicated to the Institute of France. Dr Junod and Dr Pravaz, in separate papers, afterwards each published their views and experience of compressed air as a therapeutic agent. Since then a number of essays and volumes on medico-pneumatics have been issued by Drs Milliet, Bertin, Vivenot, Lange, Panum, Sahndal, and others; a few general remarks only have been made on the subject by English writers. A very valuable paper, however, with important suggestions, was published in 1868 in the *Practitioner*, by Dr J. Burdon-Sanderson, to which attention will shortly be drawn. Medico-pneumatic establishments have been erected in various parts of France, Germany, and at Stockholm, conducted by experienced legitimate members of the profession; and the results in various forms of disease have been eminently successful.

2. MECHANICAL CONSTRUCTION OF THE AIR-BATH.

A brief description will now be given of the compressed air chamber erected in Malvern, which has been in constant operation about fifteen years. It is erected on a somewhat novel and extended scale. Connected with it and the sleeping apartments of the establishment is a spacious promenade, which affords shelter and warmth in winter, and room for in-door exercise, and also shelter in damp and stormy weather. It prevents,

in delicate cases, hazardous or mischievous exposure; and the patients, by this means, are enabled to take exercise in a regulated atmosphere before and after each bath.

The invalid first enters the promenade, which is furnished with books, paper, and writing materials for general use. Invalids in this room quietly wait their turn for admission into the air chamber. A short passage gives admission into two small divisions. The first is the room of the medical superintendent, who has command of the machine for closing or opening the air bath, regulating the pressure, temperature, communicating with the patients, of whom he has a perfect oversight by means of a glass window. The second is the ante-air chamber, which is used for transition from the one of large size, when from illness, or other causes, a patient is compelled to relinquish the use of the bath during any particular sitting.

The large apartment is a circular saloon fourteen or fifteen feet in height, and not less than ten feet in diameter, capable of containing at once ten or twelve individuals. It is conical in shape, and made of sufficiently thick iron plates, rivetted firmly together in every possible direction. The iron saloon is lined with wood, and resembles an ordinary boudoir. Windows of thick glass, several in number, give abundant light, and a bell communicating with the room of the medical superintendent induces immediate attention. The air undergoes constant change by means of an aperture with a valve at the top of the room, and the extent of purification can be regulated at pleasure. An apparatus is contrived for regulating the temperature of the saloon during cold weather. One also is constructed to cool the air during the warm season. Every precaution is adopted to render the patient at ease, and to prevent all unpleasant conceptions of confinement—to make the seance, in short, a pleasant and agreeable conversational gathering as in an ordinary room.

The condensation of the air is effected by means of a steam-

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Interior of Compressed-Air Chamber.

engine, erected at some distance from the chamber, which is in immediate communication with a pneumatic apparatus. The air is conveyed from a healthy situation in the garden by means of pipes, and is propelled into the room under the floor, and so gently diffuses its influence as not to excite the attention of the patients.

The duration of each bath is two hours. The air is gradually increased to the medical or maximum degree of pressure during the first half hour. This effected, the patient remains exactly one hour under the operation. During the last half hour, the pressure of the air is slowly reduced, until at the period of emergence it has acquired the same density as the ordinary atmosphere.

3. MODE OF ADMINISTRATION.

The extent of pressure to which patients may be exposed during their seance in the air-bath is a point of no little importance in the direction of its administration.

M. Tabarié arrived at a definite decision as the result of extended observation. He draws attention to the evil effects induced by transitory and irregular influences.

Ascertained facts demonstrate that the requisite degree of pressure need not be very high. M. Tabarié observes, "We obtain better results from moderate pressure than those which are higher; and in order to recognise this, a great difference is not required—two-fifths of an atmosphere, for the most part, succeeds better than two-thirds." Dr Milliet records the smallest amount of pressure he employs as fifteen centimetres. The maximum, he further states, may be carried to the extent of fifty centimetres—*i.e.*, an equivalent to two-thirds of an atmosphere more than the ordinary atmospheric density.

Dr Bertin observes, "It would be a mistake to believe that atmospheric pressure, as in any other influence, should be with an intensity proportioned to the need; the compression has its

curative effect, not in accordance with its proportion to the nature of the malady, *but with a fixed persistence to a given degree.* We have therefore *not to regulate the pressure according to the patients, but to render it generally as invariable as possible.*"

It would be an error consequently to suppose that as the pressure becomes increased beyond the ascertained correct standard of administration, that the beneficial effects would correspond with the additional amount of pressure. The necessary compression to produce the full benefit of the bath once attained, experience proves that to double or treble it accomplishes no beneficial end, but involves consequences likely to neutralise the objects of the operation.

A serious objection to a high degree of compression is the *time required to effect the transition*, which must be done at a given ratio, that is, the transition from the ordinary atmosphere to the point when the action becomes most efficient; and after the bath the equally gradual reduction of the pressure to that of the common air.

Experience proves that the transition periods should not exceed a limited time, or at least should not be too much prolonged. Half an hour in each case is found to be the time most suitable.

The author has found that, as a general rule of application, an increase of half an atmosphere, or $7\frac{1}{2}$ lbs. of pressure on the square inch, in addition to the common weight of the air, is best adapted to attain the medical results of the bath. The mode in which the air bath is administered has already been shown to be gradual and gentle. The increase of the compression is progressive, and the transition during the last half hour, from a high pressure to the natural density of the atmosphere, is effected in an equally slow and cautious manner. With many invalids the variation of feeling is so trifling as to induce surprise. Patients even doubt whether any remedial influence can

result from the use of a bath which occasions so trifling an alteration in their feelings. Subsequent experience will alone add conviction of the efficacious agency of a remedy so apparently inert. Properly regulated transitions are essential to the remedy. Patients should enter the bath in a state of mental quietude. Every cause of nervous trepidation should be avoided. An anxious state of mind, arising from ignorance of the process, should be removed by adequate explanation. The point on which the invalid should receive strong assurance is the fact, that while in the bath, *whatever the degree of pressure*, a perfect equilibrium from within and without is maintained *throughout the operation*, and therefore no danger can possibly ensue.

4. THE PERIOD REQUIRED FOR ITS ADMINISTRATION.

The time required to effect remedial benefit or cure of disease must depend on a variety of circumstances—the nature of the malady, the strength of the patient, the fitness of the remedy. Dr Milliet remarks, "It would be very difficult to assign a term to the probable duration of treatment of this nature; all that we can say is, that it is usually from thirty to forty baths." The author would add that, in order to test properly the value of the treatment, no patient should take less than twenty or thirty baths.

Periods of aggravation of the disease not uncommonly occur during the administration of the compressed air-bath. Dr Milliet observes, that "generally towards the twelfth or fifteenth bath distress occurred, being a return to the circumstances which decided the invalid to submit to the treatment. This return of first symptoms," he further states, "remains at most for two or three days, and soon yields to the use of the same curative agent." The author has a communication from one of his correspondents, in which he states, "that during the cure the disease seemed much exasperated, so much so, that if he had not had strong

faith in the efficacy of the treatment he should have given it up." Perseverance in the system effected great relief, if not a cure.

5. THE PHYSIOLOGICAL RESULTS OF COMPRESSED AIR.

A. *On the Respiratory Organs and Functions.*

Increase in the force of the respiratory muscles has been shown to be a primary effect of exposure to compressed air. Experiments prove that the increase of action influences both *in-* and *ex*piration. The investigations of Dr Lange and of Vivenot on this point are decisive. In my own experience on the action of compressed air on patients, the same fact has been uniformly apparent. My personal experience is equally strong. When in the bath I invariably feel unusual freedom and expansion of the respiratory action.

Increase in the vital capacity of the lungs. This fact is also established by careful experiments. Professor Sahndal notes, that "a long series of observations made on Vivenot, on Lange, on Dr Mittermaier, and on two other persons, gave a mean augmentation of 115·44 cube centimetres during the two consecutive hours they passed in the apparatus."

Vivenot summarises his observations on this point by the remark, "we have in the daily employment of compressed air, during two hours, a means of attaining a continuous augmentation of pulmonary capacity."

Slower and more decided respiration. Professor Sahndal remarks, "This fact shows itself rather quickly in most cases, and it has been verified by all who have occupied themselves with the application of compressed air." In my own experience the exceptions have been few where the respiration has not been slower and more profound. Over and over again have I witnessed patients—in particular those labouring under bronchitic asthma—enter the bath with a difficulty of breathing most dis-

tressing to witness, and after exposure to air compression for an hour, exhibit a diminution of breathing and depth of inspiration almost marvellous. In several cases the asthmatic sufferers, who literally gasped for breath, and were bent double in their agony of semi-suffocation, in the course of an hour sat up in their chairs, breathed with comparative freedom, and conversed in a manner, and expressed themselves in language, indicative of unmistakable relief. Vivenot and Lange, to establish the fact of diminution of the number of respirations under the influence of compressed air, used a specially constructed "thoracometer," and found that "the chest dilates more than before; a further proof of the augmentation of pulmonary capacity."

Professor Panum of Copenhagen has, by very careful experiments, verified the same fact. He remarks that compressed air "gives disposition to slower and more profound respirations." Professor Panum, as quoted by Professor Sahndal, found that the "mean vital position" of the lungs (its ordinary action during tranquil breathing) under the action of compressed air approaches the position occupied during the deepest ordinary inhalation.

Increase in the rhythm, or length of the respiratory act. Vivenot asserts that under compression of the air there is a change in the respiratory act, so that respiration becomes relatively longer. During respiration in the ordinary air the proportion between the length of the inspiration and that of the expiration is in general from 4 to 5. The proportion between the times of the two respirations becomes, under the action of the compressed air chamber, from 4 to 7, from 4 to 8, and even from 4 to 11.

Action of compressed air on the chemical actions of respiration. This subject involves details too minute to receive full exposition in a mere outline sketch like the present. It has, however, been ably discussed and elucidated by Vivenot, Dr G. Lange, Sahndal, Panum, and others. Two practical points, however, require notice. The first is the more copious elimination of car-

bonic acid under the influence of augmented air pressure; and the second, the freer inhalation of oxygen. These may be said to comprehend the essential objects of lung action, or what continental physicians include under the phrase of the "chemism" of respiration.

The experiments of Vivenot are interesting. The first determination of the quantity of carbonic acid contained in the air exhaled was made before entering the air-bath, at 8 P.M., the second at 9 A.M. The third trial was in the pneumatic apparatus, and commenced exactly at 10 o'clock, after exposure for an hour to air compression; and the fourth at 11 o'clock, in the ordinary air immediately after the bath. The fifth and sixth determination were made at 12 and 1 o'clock, also under ordinary atmospheric pressure. The following table gives the results:—

Vivenot.	Under a normal air pressure.		Under an augmented air pressure.		Under a normal air pressure.	
	At 8 A.M.	At 9 A.M.	At 10 A.M.	At 11 A.M.	At 12 A.M.	At 1 o'clock.
The quantity of carbonic acid in one respiration, calculated in "grammes,"	0·1983	0·2236	0·2676	0.2183	0·2177	0·2106
The quantity of carbon in one respiration, in "grammes,"	0·0548	0·05408	0·06098	0·05954	0·05937	0·05744

Vivenot tells us that in observations made on himself, the result of repeated experiments was invariably the same, a respiration in compressed air contained an average of 0·050 grammes more carbonic acid than an equal respiration under a normal atmospheric pressure.

Some experiments made by Dr G. Lange led to similar con-

clusions. The average of results obtained by experiments on Vivenot, two other persons experimented on by Dr Vivenot, and on Dr G. Lange, were as follows :—

Excess of Carbonic Acid expelled in Compressed Air compared with the quantity of Carbonic Acid expelled under ordinary conditions.

Dr Vivenot.	Mr H. T.	Madame B.	Dr G. Lange.
22·99 per cent.	24·75 per cent.	23·20 per cent.	18·08 per cent.

These results give a mean of 22·26 per cent., an excess, to use the words of Professor Sahndal, really considerable of carbonic acid expelled under the action of compressed air.

Space will not permit an explanation of the modes adopted to prevent any mistakes as to the true source of the increased carbonic acid inhaled, nor of the fact that it could not be "a consequence merely of the augmentation of pulmonary capacity." It is more than probable that the results were attributable to chemical as well as mechanical causes. The experiments and conclusions of Professor Panum on this subject, are equally corroborative. He observes, "In compressed air the 'chemism' of respiration undergoes such a modification that—the same volume of air passing through the lungs in a certain lapse of time—the absolute quantity of carbonic acid exhaled is greater then than in air of ordinary barometric pressure, all the other conditions being the same."

Professor Panum expresses his belief in the increased absorption of oxygen under increased atmospheric pressure; and Vivenot also feels able to affirm, as a result of his experiments and observation, that "there is an increase in the quantity of oxygen absorbed." Professor Sahndal adds, in reference to the marked and permanent benefit derived by patients under the compressed air treatment, "The improvement which is produced

is, I think, an effect of the oxidation of the blood, depending on a quantitative change in the chemism of respiration," &c.

Additional observations, doubtless, will further elucidate this very important point. My own personal experience, and also my observations on patients, extending over more than a dozen years, goes to prove, under the influence of compressed air, a decided increase of appetite, improved nutrition, and manifest increase in the red particles of the blood—effects which I attribute in some measure at least to its more effectual oxidation.

B. *On the Circulation of the Blood.*

The sedative effect induced on the pulse under compression of the air is most remarkable. This influence is usually more or less exhibited even when the pulse is normal. Its effects, however, on the abnormal pulse are almost invariable and decisive. The extent of this reduction of pulse varies much. In several cases the author has witnessed the reduction to the extent of nearly 30 in the minute; in very many from 10 to 20.

Professor Sahndal comments on "the slackening in the beatings of the heart and of the pulse," as a fact observed by all who have had experience in the action of compressed air. He remarks, "A long series of observations on this subject has enabled me to arrive at the result, that in 75 individuals, and during 1454 compressed air-baths, the number of beatings of the heart diminished in 64 individuals during 1352 baths of compressed air." The mean number of the diminution was 9·94 a minute. The greatest diminution observed was 26 pulsations a minute.

M. Tabarié, in his early experiments, found that the air-bath diminished the number of the heart's pulsations, and also regulated their succession.

The experience of Dr Bertin was similar. The precise effects, however, were variable. In some cases, after four or five baths,

the reduction of pulsations was only four or five per minute; in others, from the first sitting, ten or fifteen in the same period; while, at other times, he has found the diminution, after a single bath, not less than thirty to thirty-six per minute.

In a case of double emphysema, under the care of Dr Bertin, the habitual pulse was from 106 to 108. After the first sitting in the air-bath it fell to 72, then from day to day to 46, and remained at this ratio during the treatment. Afterwards the pulse did not rise above 56.

Relief of the function of respiration does not always follow diminution in the frequency of the pulse. Dr Bertin relates that in a case of palpitation, due to a rheumatic cause, the pulse fell 30 beats in a minute, while the respiration was scarcely modified. "I have seen," remarks Dr Bertin, "in the same way, in certain cases of catarrhal deafness, chronic irritation of the back of the throat, &c., the pulse greatly influenced, while the respiration preserved its normal state, from which it had not wandered during the malady." Dr Bertin had met with cases of very serious pulmonary emphysema, where the respiration did not undergo any sensible amelioration, while the pulse, habitually very frequent, diminished from the first sitting from ten to fifteen, and even twenty pulsations a minute. Dr Bertin adds (after relating a case in confirmation of these views), "And are we not allowed to conclude that compressed air has a direct and special action on the heart itself, since we find so many cases where the heart alone is influenced; so many others where the influence exercised upon it is so great that it cannot be considered as the consequence of the almost imperceptible effect undergone by the respiration." An illustrative case of the sedative influence of compressed air may be adduced. A female came under care afflicted with palpitations, induced by a violent fall. The dose of digitalis administered by her previous medical adviser did not reduce the pulse below sixty beats per minute, after the second air-bath it did not exceed forty-five.

The theory of this reduction of the heart action and pulse is somewhat doubtful. Whether it be attributable to chemical influences, or the effects of mechanical pressure, or both, remains yet to be proved by more extended observation. The effects of air compression on the venous circulation, and on the left side of the heart in particular, will shortly receive notice.

Notes of a case of pulmonary emphysema treated in Malvern in 1860, and the effects of the compressed air-bath on the pulse, are given below. The case was a very severe one, and not curable. The lady experienced great benefit, however, from the treatment. It is given to show that even in incurable organic affections of the air cells great relief is afforded *in the bath*, while the general health was greatly improved. In the note-book kept by the medical superintendent the remark is frequently made, "relieved," "greatly relieved." The subsequent history of the patient demonstrated that not only was relief obtained in breathing, but a decided permanent gain in the general strength.

	Pulse on entering the Bath.	Pulse on leaving the Bath.
1860.		
Sept. 4,	76	72
„ 5,	80	68
„ 6,	84	...
„ 7,	84	82
„ 8,	84	76
„ 10,	88	80
„ 11,	82	...
„ 13,	84	76
„ 14,	82	68
„ 15,	80	72
„ 18,	74	72
„ 19,	74	72
„ 20,	80	68
„ 21,	88	80
„ 22,	82	79
„ 24,	95	72
„ 25,	84	72
„ 26,	84	76
„ 27,	76	64
„ 28,	74	68
„ 29,	84	...

	Pulse on entering the Bath.	Pulse on leaving the Bath.
1860.		
Oct. 1,	68	64
„ 4,	73	64
„ 5,	84	73
„ 6,	70	64
„ 8,	84	60
„ 12,	72	60
„ 13,	68	64
„ 17,	72	64
„ 18,	88	60
„ 19,	74	68
„ 20,	68	60
„ 22,	80	64
„ 23,	80	64
„ 26,	76	76

C. *On Animal Heat.*

An augmentation of the respiratory action, inducing the more perfect oxygenation of the blood, and the freer extrication of carbonic acid, would lead to the supposition that an increase of animal heat would follow as a physiological consequence. The practical influence of the bath is to increase the feeling of animal warmth. Sahndal states : "Vivenot, by direct experiments, has lately verified that under the action of compressed air there is an increase of animal heat, an augmentation which obtains its maximum at the maximum point of increased air pressure." The remark is also made, that the animal heat diminishes with the diminution of air pressure, a point to which the attention of the author has often been called; and he has, in consequence, not unfrequently directed, during the winter season of its administration, a greater admission of artificial heat during the latter portion of the seance.

D. *On Muscular Power and the General Strength.*

The influence of air compression on the respiratory muscles has already received notice. It appears probable that the tonic influence so induced acts equally on the whole muscular system.

At all events, I have noted, as an almost invariable effect of the air-bath, increase in the general strength. This has been the experience of Sahndal, Lange, Bertin, and other physicians, who have made the subject a matter of special investigation. Dr J. Lange instituted some special experiments to test the point. He found that a weight, which, under ordinary air pressure, could only be raised with extended arm during a few seconds, and with great effort, was, under augmented air compression, raised more easily, and might be increased in proportion as the degree of air pressure increased. He measured the muscular power of a young man of twenty, under ordinary air pressure, at intervals of ten minutes, and during five consecutive days. It was observed, when once the limit of the muscular strength of the young man was determined, the increase of that force did not arise from the repeated exercise; for each time, during the latter experiments, signs of fatigue were sooner observed. In making these experiments, however, immediately afterwards, at intervals of ten minutes, on compressed air, they verified a real increase of muscular strength. This increase of strength would appear to have manifested itself in proportion as the pressure increased, and not only at the time of diminution of pressure, but also under an ordinary atmospheric pressure.

The results of two experiments, made by Dr J. Lange, are given in the following table :—

Date.	Height of Barometer.	M. F., 21 years. Weight lifted.		M. M., 30 years. Weight lifted.	
		Before Bath.	After Bath.	Before Bath	After Bath.
12 Dec....	759	...	...	10·0	10·75
19 Feb. ...	740	10·4	11·2	11·0	11·4
9 Jan....	748	11·2	11·4	11·4	12·0
27 Feb. ...	766	11·2	11·3	12·1	13·0
24 April..	761	11·5	12·0	12·5	13·0

The following extract from Dr Bertin is given in full, because it so closely accords with the author's own experience and obser-

vations. It was published in the author's work on "The Compressed Air-bath," issued in 1860. Since that period, very extended observations have been made, and with similar results. The increase in strength in cases of asthma—in other pulmonary diseases which have not been susceptible of cure—the increase in appetite and power of digestion—the evident increase of the red particles in the blood, and greater power of muscular exertion—these unerring indications of the beneficial influence of compressed air—have been evidenced in so many cases as to amount, in the practical sense of the word, to pure demonstration :—"From the first sittings in compressed air, there is often established a notable amendment in the strength of the patient. Exercise has become less painful to him; and the much greater facility he has acquired to accomplish and sustain the fatigue he was before incapable of supporting, is not one of the least of the encouragements he derives from the first trial.

"The effect which is here noticed, as produced by the first baths, is not in all cases manifested with equal celerity, yet it is especially interesting to notice how quickly it is seen in some persons who have suffered for a long time from difficulty of breathing (dyspnœa) connected with organic pulmonary disease. Even when the disease itself has not been sensibly diminished, still the beneficial effect resulting from the greater regularity and restorative power of the respiration during the continuance of the bath, is diffused through the whole system, and becomes the source of a new energy in all the functions. It is difficult to form an idea of the beneficial influence which the consciousness of this acquired strength exercises on the sick, even when it is manifested but in a small degree.

"It has frequently happened in asthmatical cases, when the strength has been increased and the respiration quieted by a few air-baths, that some imprudence or unforeseen cause has brought on a sudden attack of distressed respiration. In most cases, there was not much difficulty in its removal, yet, neither during

the continuance of the attack nor after it was over, was there the slightest diminution in the patient's strength. When the compressed air is used for some time, its invigorating power is more clearly seen, as it is then the result of the daily improvement imparted to all the functions of the lungs and the digestive organs. Under these circumstances, the activity of digestion is proportional to the activity of respiration; the appetite usually increases, and greater regularity in digestion renders easier and more complete the conversion of the food into blood. The beneficial effect of the improvement in the restorative functions is evidenced in persons suffering from anæmia, induced either by repeated loss of blood or poor diet, and sufferings resulting from chronic disease. In these cases, after a few baths, there is a daily improvement in digestion, the complexion assumes a healthier look, the pulse acquires firmness and power, exertion becomes easy and less fatiguing, whilst entire inactivity is rendered irksome, and the regular action in all the functions produces of itself an ameliorating effect. These constant restorative effects of compressed air (the reality whereof is shown in the great benefit which young children of feeble constitution placed in hospitals for the lame usually derive from it) render it a very valuable remedy in the treatment of chronic affections, and also in some acute diseases which allow of its application. Moreover, whilst the cure of this diseased condition is going on, the strength of the invalid not only suffers no injury from bleedings, from more or less frequently repeated evacuations, or from the application of disagreeable and painful local irritants; but, as the restorative action of compressed air does not generally depend on the pathological condition of those organs which contribute the beneficial effect, the general strength is thus preserved, and most frequently increased. Moreover, when other methods of cure have been adopted, and the disease arrested, the practitioner must set about repairing the loss which the mode of cure entailed, and he must incessantly guard against any shock which

might utterly destroy a constitution already greatly enervated. But after treatment in compressed air (through the salutary influence exercised every day upon the whole system), there is, so to speak, no period of convalescence. The cure of the diseased organs and the augmentation of the strength are contemporaneous; and when the former are restored to their natural condition, the general health returns to its normal state.

"Consequently, health succeeds immediately to sickness, and if, in many cases cured by compressed air, its salutary influence is undiminished, even when the use of it has been discontinued, this arises from the healthy condition of all the functions, the harmonious action established throughout the system, and the return of the general strength, uniting for the progressive and speedy improvement of the health."

E. *On the Secretions.*

The various *secretions* of the animal economy, as, for example, the salivary, the mucous, and the gastric, are separated from the blood, and, of course, depend for their quantity and quality on the condition of the vital fluid. Any process, therefore, which, under abnormal conditions, more effectually oxidises the blood, as a natural consequence stimulates the functions, and in an especial manner those involved in the process of secretion. A more effectual oxidation of the blood equally tends to stimulate the function of secretion, and thus assists in its more thorough purification.

Dr Bertin found that compressed air increases the activity of the salivary glands; hence, commonly, a considerable flow of saliva into the mouth during the operation. The same influence not extending to lachrymal or other similar glands, led him to inquire whether compressed air does not exercise a more direct and specific action on the salivary gland than on any other portion of the glandular system.

Dr Milliet remarks—"One of the effects of the use of com-

pressed air is the increase of the secretions and of absorption: the activity thus induced has appeared to me to be derived from the venous circulation, which is always larger and more complete while the body is submitted to an elevated pressure."

6. THE THERAPEUTIC EFFECTS OF COMPRESSED AIR.

The claims of compressed air as a therapeutic agent have been thus briefly stated. A necessarily equally brief statement of its application as a remedial agent in some forms of disease may now be added. A brief *resumé* only can be given.

Some practical therapeutic deductions may be drawn from the foregoing experimental observations.

The physiological influence of compressed air is manifest. On what change or changes in the relations of the animal functions does this influence depend? The agency is increased atmospheric pressure. How does atmospheric compression act?

1. *Mechanical influence* obviously is a primary and important agent. The functions, by increased pressure, are energised, and that energy is sustained for a period adequate to induce practical physiological results. In great measure, however, the therapeutic influence of compressed air must be attributed to its influence in altering the *distribution of the blood.* This point will receive consideration shortly.

2. *Is increased absorption of oxygen,* as urged by many, a primary result? The agencies—mechanical—of respiration are rendered more active, the pulmonary muscles act more vigorously, the inspirations are deeper and sounder, and we may fairly infer that the amount of air absorbed is increased in proportion.

The therapeutic value of air compression on these data will be greatest in cases where, from various circumstances, lung action is feeble, and consequently blood purification imperfect. In diseased conditions of the pulmonary tissue, one would anticipate still greater benefit.

3. *Improved nutrition.*—How far this is dependent on in-

creased absorption of oxygen is not clear. Oxygen unquestionably stimulates functional action, and improved nutrition may be the result.

4. *Retardation of the action of the heart* has been shown to be an invariable effect of the influence of compressed air. I now quote the results of the observations and inquiries of the eminent physiologist Dr J. Burdon-Sanderson. He observes—"The effects observed in every instance may be summed up in a few words—*diminished amplitude of the oscillations of the lever, hence diminished expansive movement of the arterial wall; increased obliquity of the ascending limb, hence more gradual filling out of the artery and postponement of the acme or maximum of expansion.* Thus, as Von Vivenot rightly observes, the pulse, besides being retarded, assumes the character of the *pulsus lentus*—that form, in short, which characterises *increased arterial tension.*" Again—"In five individuals simultaneously experimented upon (including the author) *the mean frequency of the heart's action increased from* 72 *to* 86, *the radial pulse became manifestly more voluminous, and the extent of its expansive movements of the artery became greater.* Along with these changes all experienced a sensation of increased *warmth of the skin,* notwithstanding the considerable cooling of the air in the chamber *consequent on the diminution of tension. Smarting of the conjunctivæ, with vascular injection, vertigo, confusion of thought, and neuralgic pains in various situations,* were other symptoms noted."

"Other results," continues Dr Burdon-Sanderson, "strikingly illustrative of those already referred to, were obtained by Von Vivenot by the direct observation of the condition of the blood-vessels. Thus, observations with the aid of the ophthalmoscope, showed that *the blood-vessels of the retina became more slender and contained less blood as the pressure increased;* again, in a white rabbit it was observed that the ear became pale, and that *vessels which before were distinct became absolutely invisible;* corresponding changes were observed in the colour of the iris and pupil."

The deductions which Dr Burdon-Sanderson draws from these facts are important :—"From all of these facts it is to be inferred that the fundamental physiological effect of compressed air consists in its *altering the distribution of the blood, i.e., diminishing the quantity or volume of blood contained in the veins and auricles*, and consequently *increasing the quantity contained in the ventricles and arteries.* Its secondary effect on the heart admits of complete explanation on the principles which I have developed in my Croonian Lecture.* *The effect of diminished fulness of the venous system is to retard the filling of the ventricles during their period of relaxation, and consequently to lengthen the diastolic interval and diminish the frequency of the pulse.* For as the time occupied by the heart in contraction is subject to little variation in the same individual, the interval between successive contractions obviously depends on the duration of the diastolic pause.

"The bearing of these considerations on the therapeutical action of compressed air as a means of relieving dyspnœa is not difficult to explain. *The cases in which it is useful are precisely those in which the dyspnœa is dependent on dilatation of the right side of the heart, fulness of the venous system, impairment of the pulmonary circulation, and consequent emptiness of the arteries*—a state of things which exists *in a vast number of cases of chronic bronchitis with emphysema.* In other words, the dyspnœa which it relieves is that which arises when *the feebleness of the contraction of the left ventricle and the diminution of arterial tension are due, not to defective vigour of the heart itself, but to interference with its supply of blood* a tergo. In all such cases immediate relief may be confidently expected by an agency which tends to facilitate the filling of the left ventricle, so that at the end of each period of relaxation, the mass of blood which it contains is sufficiently large for it to grasp vigorously in its systole."

* On the Influence exercised by the Movements of Respiration on the Circulation of the Blood. Phil. Transactions, 1867, p. 571.

Dr Burdon-Sanderson concludes his valuable article as follows:—

"Admitting for a moment that the physiological action of increased atmospheric pressure is such as I have represented it to be, and that it can be so controlled as to be effectual in the management of disease, its superiority to the methods now in use can scarcely be doubted. The morbid condition which it is calculated to counteract, is the immediate cause of death in a large number of cases—all those cases in which the mode of death is characterised by a gradually increasing dropsy, arising from venous congestion independently of organic disease of the kidneys.

"In such cases experience teaches us that diuretics and purgatives are usually the most effectual means at our disposal, yet how unsatisfactory such a mode of treatment is in its principle! We are watching the gradual though distant approach of death—the heart is becoming weaker—primarily from want of blood to work with, secondarily from want of blood for its own nutrition. The arteries are becoming empty, the pulse quicker, more compressible and more jerking, the veins fuller, the connective tissues more and more hopelessly soaked with serum. The immediate source of danger is, in a great measure, mechanical. The venous congestion must be relieved, the heart invigorated, to accomplish which we have to tease the kidneys with calomel and digitalis, and the bowels with cream of tartar and jalap. The danger is averted, and the patient recovers; but in the process of cure there is much disintegration of living tissue, much irreparable waste of the vital energy which was stored up in it. If there is a reasonable hope that by substituting a mechanical for a chemical agency we may be enabled to get the good without the evil, the experiment certainly ought to be made, not of course by sending patients to Reichenhall or Wiesbaden, but by having the apparatus in our London hospitals. Experience has already, I think, shown its efficacy for the

relief of suffering. I do not think that it is too much to hope that it may also be found available for the saving of life."

7. SPECIFIC ABNORMAL CONDITIONS, OR DISEASES IN WHICH COMPRESSED AIR HAS BEEN FOUND TO BE BENEFICIAL.

A. *Impaired Nutrition. Strumous conditions of the Blood.*

Observation in a considerable number of cases has convinced me that in defective conditions of the blood—those especially ranked under the general phrase, anæmia—and scrofula, compressed air is a powerful and beneficial agent. In numerous strumous cases in children, I have noticed rapid improvement after a few weeks' air-bath treatment. The appetite has invariably increased, and with it more vigorous digestion. Better nutrition is seen not merely in healthier colour, but in increase of tissue and strength. I may state that my experience is similar in cases of chlorosis.

B. *Affections of the Auditory Organs.*

In chronic deafness arising from functional causes — in catarrhal affections of the Eustachian tube, the air-bath is very useful. In many cases deafness arises from obstructions in the auditory passages, dependent on catarrhal influence,—in these the effect of air compression is remarkable. In most cases, while in the bath, the ticking of the watch becomes more apparent. In one case the patient was enabled, after a single seance, to hear distinctly the ticking of his watch, which previously he had not been able to do for two years. Dr Bertin of Montpellier mentions numerous cases of catarrhal deafness which compressed air has cured.

Dr J. Lange of Johannisberg cites a number of similar cases in which air compression effected a cure. Two of these cases, Professor Sahndal informs us, he could verify by personal observation. In these cases the air-douche had failed to induce

benefit, while the continuous action of the air-bath effected a cure.

M. Levinstein advises the use of compressed air in cases where defective hearing arises from anæmia or general debility.

Professor Sahndal gives some interesting data of cases treated in the medico-pneumatic establishment at Stockholm. In 127 cases of chronic catarrh of the Eustachian tube and tympanum, the result of the treatment was known in 114 cases. In 62 cases the result was a cure, or very marked improvement. In 52 patients he could not verify any marked improvement.

C. *Affections of the Vocal Organs and Air-Tubes.*

In various catarrhal affections influencing the air tubes, I have witnessed considerable benefit under air compression. Its influence on those congestive irritations which often extend down the larynx, and as frequently influence the voice, is remarkable. The case related by M. Francœur, Professor of the Faculty of Sciences, Paris, is an illustration in point. "After having been for five weeks this winter affected with a very severe catarrh, I was seized with such an affection of the larynx that for more than a month I was totally deprived of voice, and was fatigued even by speaking with the lips only. When I had decided upon making trial of your process, everything was opposed to my cure—my age (sixty-six years); the feebleness caused by three months of suffering, confined me to my arm-chair, or to my bed; a cold and moist season, which always troubles me even when in health; and lastly, it was the fourth attack of this complaint. Thus I did not flatter myself, and did not go into the apparatus without a kind of repugnance. Well, after the second sitting, I for some hours recovered my voice; after the third I was able to speak freely, and even to sing a scale; and when, after twelve sittings, accidental circumstances hindered the continuance of the baths, I regretted this necessity because I was not entirely cured. I could speak as usual, sing a scale and a quarter, which

is the ordinary extent of my voice, but the fatigue which I felt, and especially towards evening, made me think something wanting to my cure. However—and this is truly an astonishing fact—my cure continued to progress without foreign aid, and, fifteen days afterwards, I was so well and completely restored that I felt nothing more afterwards. I speak loudly, sometimes very loud and for a long time, without having cause to repent of it, and notwithstanding a very long winter, I find myself precisely in the same state as before my attack."

The cases of benefit or cure in cases of chronic laryngitis and bronchitis, as related by Lange, Bertin, Milliet, and others, are numerous. I must, however, refer my readers to the works of those writers for a record of cases. My own experience is confirmatory, and I could relate various cases of chronic maladies of the mucous respiratory membranes, where great benefit has been derived from compressed air—in some a complete cure. Dr Milliet, in his little work entitled, "De l'Air Comprimé comme Agent Thérapeutique," relates the case of M. Cordes, a Protestant pastor, introduced to him by Dr Devay, to be treated for chronic laryngo-trachealis, which had altered his voice and prevented him from preaching. There was pain in the region of the larynx, with mucous expectoration, and a great susceptibility to cold. After forty baths the voice was restored, the pain and expectoration disappeared, and, shortly after, M. Cordes was able to recommence and continue preaching. Some time afterwards, Dr Milliet saw M. Cordes, and adds that he preaches very frequently, has a clear voice, and no bad symptoms have reappeared.

The case of M. Ismael, baritone of the great theatre at Lyons, is related by Dr Milliet. This gentleman had an attack of bronchitis which completely took away his voice. The first bath restored him all the register of the bass, the second of the high notes, but without regaining a single note of the middle. The third bath restored the voice entirely.

I may refer to the able work of Dr Bertin, of the medico-pneumatic establishment of Montpellier, for a record of numerous cases of successful treatment of chronic catarrh, chronic bronchitis, laryngo-bronchitis, and loss of voice.

D. *Emphysematous conditions of the Lungs, and Asthma.*

In pulmonary emphysema very varied results have followed the administration of compressed air. This remark, of course, does not apply to those organic lesions of cellular and intercellular structure, or that degeneration of tissue in which no cure can by possibility be effected. In cases where the dilatation of the air vesicles is only partial, where the air cells have not been broken down, and involved a number of lobules into one mass of destruction—in cases of weakness of the muscular fibres—in general flaccidity of the lung structure—in various forms of congestive irritations of the mucous structure—in catarrhal lodgements of mucus, inducing viscid obstructions to free lung action—in these and analogous conditions, I have found the compressed air-bath marvellously beneficial, often a radical cure. Professor Sahndal, in reference to the use of compressed air in *Emphysema pulmonum*, observes, in unqualified language, "As long as it only consists in a vesicular ecstasy, more or less extended, the emphysema of the lungs is cured in all cases by compressed air, which restores to the pulmonary tissue its elasticity and contractility." Dr Sahndal adduces the case of a patient who had been a severe sufferer from asthma and emphysema for eight years, and latterly tormented with two or three attacks every week. After a course of air-bath compression, "no attack returned, and the patient was perfectly cured."

Even in more complicate cases, where structural mischief is evident, and where a cure is impossible, much relief may be obtained by air compression. I adduce a case in illustration:—

A lady, aged forty-six, had for years been a severe sufferer from repeated attacks of bronchitis, pulmonary engorgement, and emphysema. The condition of lung engorgement was not unfrequently attended with severe attacks of hæmoptisis or vomiting of blood. She ultimately died under an attack of pneumonia. The post-mortem examination displayed considerable structural mischief.

It was a case hopeless in respect to a cure, but one in which it was thought desirable to try the effects of compressed air as a palliative agency. Each time when she entered the air bath, the breathing was most distressing. Often she was bent double from asthmatic condition, and the features exhibited signs of the most painful disquietude. In a brief time, very manifest relief was obtained, and in an hour I have often seen the invalid sitting upright in her chair, and conversing with cheerfulness and ease. Some extracts from notes taken at the time may be adduced in proof of the relief afforded in cases where a cure is physically impossible. They will also tend to note the almost uniform effects, in such cases, of compressed air on the respiration and the pulse.

CASE—A LADY, AGE 46.—*Chronic Bronchitis; Emphysema; Spasmodic Asthma; Pulmonary Engorgement.*

Date.	Pulse on entering the Bath.	Respiratory Movements.*	Result.	General Remarks.
1860 Aug. 27	114	Laborious and distressing.	Pulse fell 10.	The respiration considerably relieved. Benefit was experienced at a pressure of 2 lbs. Dyspnœa returned as the pressure was removed.
,, 28	114	Do. do.	Pulse fell 10.	
,, 30	114	Do. do.	Pulse fell 14.	
,, 31	100		Pulse fell 8.	Relief not so decided at the 2 lb. pressure.
Sept. 1	108	Since the night of the first, the breathing has been laborious. After a seance of 15 minutes it became easy, and has continued so until now (Sept. 3). The ease became apparent on a pressure of 4 lbs.		
,, 3	108			
,, 4	104		Pulse fell to 95.	Distress in breathing much relieved.
,, 5	110		Pulse fell to 100.	This at a pressure of 7½ lbs.; at the termination of the seance it was 98. Dyspnœa much relieved.
,, 6	106	Respiratory movements on entering, 40; at the close, 40.	On pressure of 7½ lbs., the pulse fell to 100. On leaving the bath it was the same.	Breathing relieved.

* On entering the bath each day, the respiratory movements averaged nearly 40 in the minute.

Date.	Pulse on entering the Bath.	Respiratory Movements.	Result.	General Remarks.
Sept. 7	110	Respiratory movements on entering the bath, 38; on leaving the bath, 32.	At maximum pressure, pulse fell to 100; after an hour and a quarter, to 96-98. On diminishing the pressure, it rose to 103, 108, and at the close to 110.	The same decided relief experienced.
,, 9	100		Pulse fell to 96, and continued at that number the greater portion of the seance.	The same relief.
,, 10	108	Respiratory movements, 36.	Pulse 100 at the close.	The same relief.
,, 11	100		Pulse 92; on going out it was 94.	
,, 13	104		Pulse fell to 100, and remained the same.	The last two days comparatively free from asthma.
,, 14	104		Pulse reduced to 96; at the close, 98.	Dyspnœa relieved. The asthmatic attacks, when they occur, are as strong as ever, but the after exhaustion decidedly less.
,, 15	104		Pulse immediately fell to 96 and remained the same to the close.	Relief as usual.
,, 18	104		Pulse fell to 96; at the close it was 102.	Do. do.
,, 19	108		Pulse fell to 96; at the close, 104.	Do. do.
,, 20	104		Pulse fell to 96; at the close, 100.	Do. do.

Date.	Pulse on entering the Bath.	Respiratory Movements.	Result.	General Remarks.
Sept. 21	112		Pulse fell to 104, 102, 100.	The breathing on the 21st was *very laborious and distressing.* At a pressure of 4 lbs. the dyspnœa began to subside, and before the maximum was attained, the violent and deep inspiratory efforts were removed, and the breathing became *tranquil.*
,, 22	112		Pulse fell to 97; at the close, 100.	
,, 24	112		Pulse fell in forty-five minutes to 95; at close, 100.	Relief considerable, but rather less than usual.
,, 25	108		Pulse fell to 102; at the close, 104.	
,, 27	100		No alteration of the pulse observed for the first time.	
,, 28	108		Pulse fell to 96; at the close, 100.	
,, 29	112		Pulse fell to 94; at the close, 95.	
Oct. 1	104		Pulse fell to 99; at the close, 100.	
,, 2	104		Pulse fell to 100.	
,, 3	104		Pulse at the close, 97.	
,, 4	104		Pulse fell to 96.	
,, 5	108	Respiration laborious.	Pulse fell to 96.	Dyspnœa uniformly relieved in the bath. Gales of wind from W.N.W. Barometer falling.

Date.	Pulse on entering the bath.	Respiratory Movement.	Result.	General Remarks.
Oct. 6	100		Pulse fell to 92; at close, 96.	
,, 8	100		Pulse fell to 96; at close, 96.	
,, 12	100	Comparatively tranquil.	Pulse fell to 92; the same at the close.	
,, 13	98	Laborious respiration.	Pulse fell to 90; at close, 96.	
,, 15	100	Laborious respiration.	Pulse fell to 92 at the close of the seance.	On the evening of the 15th, an attack of hæmoptysis, which continued during the night and early part of the following day, to the extent in all of an ounce, or a little more. The breathing was relieved, as usual, after the loss of blood. Previous attacks had been much more severe.

The number of persons in the bath during the seances recorded above, frequently was seven, eight, and even nine, and therefore exceptional. The temperature of the bath also varied, and this unavoidably from the state of the weather. The patient whose case is recorded under ordinary circumstances, sat in a room with the temperature always as nearly as possible 62. When the temperature rose to 64, the lady felt the heat oppressive, and resorted to the use of her fan. In the air-bath the respiration seemed uninfluenced by temperature. At different sittings the temperature of the air-chamber was 59, 60, to 68, and in one instance, when ten persons were in the room, at the expiration of an hour, the temperature rose to 73, and at the termination of the seance, fell to 69; yet in none of these sittings did the

patient complain of uncomfortable heat, or suffer from the transition.

In six persons in the same bath, and exposed to the same pressure, the result was the reduction of the pulse as follows :—

	Entering the Bath.	Leaving the Bath.
P.	94	80
H.	103	96
S.	96	92
J.	70	64
W.	85	68
C.	100	92

In a case of excitable pulse, the following were the results of four observations of the pulse during the ordinary sitting of two hours, the maximum pressure being $7\frac{1}{2}$ lbs. :—

First.	Second.	Third.	Fourth.
124	112	124	108
Irritable and small.	*Full and less irritable.*	*Soft.*	*Soft.*

My experience of the air-bath has been large in cases of spasmodic asthma. In a mere outline sketch I can only advert to a few. One was the case of a young lady, whose attacks were periodical and distressing. She made two or three visits to Malvern of about a month in duration, each time experiencing marked benefit, and ultimately got quite well. Another case was that of a young lady whose attacks usually were long and exhaustive, reducing her to a condition of great weakness. In a month she was able to ramble on the hills, having gained not only relief from asthmatic suffering, but flesh and strength. A similar case is at present under my care, with equal benefit.

E. *Pulmonary Consumption.*

In cases of pulmonary consumption in its advanced stage, physicians differ much as to the influence of compressed air. My experience in several cases is favourable. No cure was anticipated, but relief of the more urgent symptoms was unquestionable. This was exhibited in the reduction of the pulse

and amelioration of the cough. I briefly adduce one case, that of the Rev. W. ———, a clergyman, who had resided for a long period in the Great Cayman Island, West Indies, from whence he had returned fourteen months before his visit to Malvern. During this period he had a severe attack of hæmoptysis, and it was ascertained that there was a cavity in the right lung immediately under the clavicle. The respiratory murmur on examination was dull. There was evident and advancing mischief in the appearance of this lung. This patient was subjected to a long series of air-baths. After the administration of twenty the effects induced were most favourable. The pulse was reduced in frequency, but gained in tone—the respiration increased in strength—the cough gradually lessened in its violence, and at length disappeared—the increase in appetite and general strength was considerable, and the patient left Malvern relatively well. He survived some years, returning to the exercise of his missionary labours.

Dr Milliet, in his "De l'Air Comprimé comme Agent Thérapeutique," adduces several cases of cure in pulmonary phthisis of the second degree. One case was that of an unmarried female of twenty-two years of age. Sixty baths effected a complete cure. The other patient, aged twenty-seven years, had cavities in the top of the right lung, and was comparatively cured after sixty baths." Dr Milliet, after some extended observations, remarks—"It is sufficient to affirm that this curative means is efficacious in all chronic diseases of the organs of respiration, from the most simple catarrh to the most complicated pulmonary emphysema. To these must be added pulmonary phthisis in the first and second stages. In persons afflicted with this last disease, and who have been examined by Professor Bouisson of Montpellier, and by Dr Devay of Lyons, the success obtained has not been below our hopes. Dr Devay, in his pamphlet on the application of the compressed air-bath in severe affections of the respiratory organs, informs us that in seven cases of pulmon-

ary phthisis of the first and second degree which he submitted to this mode of treatment, he established the cure of six.

Dr Bertin, in his work, "E'tude Clinique de l'Emploi et des effets du Bain d'Air Comprimé," &c., gives, at considerable length, the result of his observations of the influence of compressed air in pulmonary phthisis, not merely in its first stage, but in cases of the second and third degree. These cases are related with considerable care, and at least exhibit the influence of air compression in relieving some of the more urgent and distressing symptoms of this widely extended malady. Even as a palliative—exercising, as it unquestionably does, a sedative influence on the pulse, and inducing more equable circulation and freer lung action—it deserves medical consideration. Dr Bertin remarks, that though he was far from presenting compressed air as an assured remedy against phthisis, yet he has seen under its influence "the cruel malady cured at all periods;" he has also to register many failures, even where he thought he could reckon on success. A few cases, in brief, may be adduced from the work of Dr Bertin, of relief or cure.

Case 1. Girl, age 9—severe hooping-cough for 4 years, pulmonary phthisis, 1st degree, cured, p. 571.
2. Male, age 35—P.P., 1st degree, hereditary, a brother and sister had died of it, cured, no return of the disease after 2 years, 45 baths, p. 576.
3. Unmarried girl, age 21—P.P., 1st degree, deranged M. function, 17 baths, cured, p. 580.
4. Male, age 24—P.P., 1st degree, hæmoptisis, 49 baths, cured, p. 583.
5. Male, age 18—P.P., hereditary, 26 baths, cured, no relapse in 2 years, p. 588.
6. Married woman, age 34—P.P., 1st degree, cured, 50 baths, p. 593.
7. Unmarried woman, age 23—P.P., 1st degree, a sister died of P.P., cured, 85 baths, no relapse in 8 years, p. 600.
5. Married woman, age 24—P.P., 1st degree, repeated attacks of bronchitis-hæmoptisis, cured, 45 baths, p. 606.
9. Unmarried woman, age 34—P.P., 1st degree, cured, 40 baths, relapse from overwork, again cured, no relapse in 7 or 8 years, p. 611.

10. Married woman, age 28—P.P., 1st degree, so weak that she could scarcely speak, miliary tubercles in great part of both lungs, cured, 67 baths, no relapse after several years, p. 617.
11. Male, age 25—P.P., 1st degree, cured, 72 baths, no relapse, p. 622.
12. Unmarried, 25—P.P., 1st degree, relieved, but died 2 years afterwards of P.P., 3d degree, p. 627.
13. Married, 30—P.P., 1st degree, cured, 50 baths, no relapse in 11 years, p. 632.
14. Male—P.P., 2d degree, relieved, but through exposure a relapse, restored to health by a second course of treatment, 10 baths during the first course, 11 baths during the second, p. 637.
15. Male, M.D., age 32—P.P., 2d degree, cured, 35 baths, p. 643.
16. Married female, age 28—P.P., 2d degree, after 35 baths much restored, obliged to return home, health continued to improve, p. 648.
17. Male, age 17—P.P., 2d degree, vesicular emphysema, much relieved, 48 baths, p. 653.
18. Male, age 27—P.P., 2d degree, cured, 44 baths, p. 659.
19. Married, age 26—P.P., 3d degree, cured, 36 baths, lived for 10 years, p. 663.
20. Married, age 27—P.P., 3d degree, much relieved after 52 baths, returned home, came again and had 30 baths, enjoyed good health for several years, p. 670.
21. Married, age 31—P.P., 3d degree, one brother died of consumption ; Dr Bertin dissuaded her from coming, so severe were her ailments ; after 108 baths she returned home, having lost cough and expectoration, and regained flesh and strength; after a fresh attack she succumbed, p. 675.
22. Married, age 48—P.P., 3d degree, completely cured, 39 baths, lived 8 years afterwards, p. 698.
23. Male, age 32—P.P., 3d degree, quite cured, 28 baths, able to continue a laborious and fatiguing life, p. 703.
24. Male, age 35—P.P., 3d degree, greatly relieved, cure incomplete by reason of the hot weather compelling removal, 47 baths, p. 707.
25. Male, age 40—P.P., 3d degree, quite cured, 28 baths, unable to stay longer, quite well 7 years afterwards, p. 711.
26. Male, age 44—P.P., 3d degree, quite cured after 72 baths and went home ; returned, took 27 baths, quite restored, p. 716.
27. Male, age 44—P.P., 3d degree, quite restored, 69 baths, p. 722.
28. Male, age 37—P.P., 3d degree, restored to health, 82 baths, returned to Buenos Ayres, led a life of great fatigue ; another

attack, 20 more baths, with considerable relief and hopes of a cure, p. 731.

29. Married, age 40—P.P., 3d degree, complete re-establishment after 53 baths, retained her health after 2 years, p. 689.

30. Unmarried, age 21—P.P., 3d degree, rapid attack, two uncles had died of phthisis, after 19 baths thought herself cured and resolved to return home; the disease was only checked for a time, resumed its course, and carried her off, p. 683.

Drs Storch and J. Lange express little or no confidence in the use of compressed air in tuberculosis when the disease has arrived at the stage of cavities in the lungs. In the cases tried, even no palliative influence was observed. It is only right to state that, in the two cases mentioned, the disease had advanced very far, and the patients were only admitted into the chamber after earnest entreaty. Professor Sahndal, in mentioning these cases, in a note remarks that it has happened more than once to him to see at Stockholm a palliative influence produced during the sittings even in persons with whom the tubercles were in a softened state. He states in the body of his work, "Des Bains d'Air Comprimé," in forcible language, his opinion that compressed air has at all times the power to lessen the progress of the malady; and he alludes to many patients in whom exposure to its influence has been succeeded by healthier lung-action, a diminution of the cough and expectoration, a cessation of night perspiration, and an increase of muscle and strength.

Dr Storch has published some details of the case of a physician, Dr G., as given in the patient's own language :—

"It would be too long to give here a complete account of my disease; I will confine myself to giving just a few diagnostic signs. About twelve years ago I was attacked by an exsudative pleurisy, which was complicated by an abundant hemoptysia (I had before been in a state of general weakness, and compelled to an involuntary inactivity during more than a year), then by a chronic bronchitis, which seems to have brought on, in the course of years, a dilation of the bronchia (the sound of the percussion was stifled in some parts of the right lung); some slight

hemoptises, which were often reiterated, also appeared,—frequent pleurodyniæ, which were on the point of becoming asthmatic attacks,—intercurrent hemorrhoidal congestions, accompanied by irregular beatings of the pulse and loss of blood '*per os et anum*;' in short, a general enfeebling, both intellectual and physical. It is easy to see that, in entering the pneumatic apparatus, I was not charged with too light a burden.

"That which just at first attracted my attention, after the employment of a few baths, was slight traces of blood in the expectorations. I did not know whether this fact arose from an accidental cause, or if I should see therein a proof that the air had penetrated the portions of the lungs which had remained, so to speak, hitherto inactive, and which could not immediately perform their normal functions. The fear has often been expressed lest the inhalation of compressed air should provoke congestion in the interior organs of the body, and occasion, above all, hemoptysis; but this fear is, in my opinion, much exaggerated. It must be remembered that the inhalation of compressed air needs no effort. The thorax raises itself of its own accord, respiration becomes more easy, is accompanied by a feeling of comfort, and, at the same time, there is a slackening in the circulation of the blood and in the beatings of the pulse. One fact is certain, which is, that since I have had no more hemoptysis, and have not even perceived traces of blood in the expectoration, the palpitations of the heart had also quite disappeared.

"After having visited the establishment two or three times a week during the whole winter, I cannot now doubt that compressed air can alleviate, and even cure, chronic bronchitis, and prevent acute colds. Although the winter has been very severe, and I have been going about from eight A.M. to three or four P.M., I can certify that, contrary to that which happened to me very often before, I never found myself for a single day obliged against my will to stay in any room; that I have not been inconvenienced by the slightest cold, and that my ailment has not grown worse.

The violence of the fits of coughing has, on the contrary, diminished, as well as the quantity of expectoration, which has also undergone a favourable change in quality.

"As to the pleurodyniæ, if we may so call the attacks of pain above mentioned, I have hardly suffered at all from them this winter. More than once, feeling a pleuritic pain, I have taken a compressed air bath; the pain ceased immediately, or at least disappeared a few days afterwards, while formerly it persisted during weeks and months. This is why compressed air seems to me to deserve to be regarded as a precious remedy to complete the cure of pleurisy. I am, besides, perfectly convinced of the tonic action that this air exerts on the organism and on the blood, an action accompanied by an increased feeling of comfort, or a better appetite and sleep.

"I may then say that the effect which I expected from compressed air on the chronic affections from which I suffered has been quite realised."

Are these effects of compressed air merely temporary, or do they induce more permanent physiological and therapeutic results?

Theoretically we should conclude, that in a large number of cases, where there does not exist any formidable extent of organic disease, the effects must be permanent,—permanent because the direct influence of compressed air is tonic, and the secondary effect is to introduce into the blood an element which in imperfect lung-action it lacked—its natural and essential constituent. Professor Sahndal, endorsing the experiments of Professor Panun, observes: "One breathes then during a compressed air bath with more dilated lungs, and that *deeper breathing continues for some time even after the compressed air bath.*"

How often in certain forms of anæmia, or bodily weakness arising from poverty of blood, a lack of energy is manifest *to commence the cure*, a primary impulse to stimulate the feeble

powers of recuperation? In how many cases a visit to the seaside or exposure to mountain air supplies the stimulus required? The first step accomplished, the rest is a work of time. Each day brings with it a new accession of strength; each new accession of strength gives more power of recuperation—and a cure is accomplished.

Professor Sahndal observes, in respect to his own experience, that it was not in a certain number of cases *during the treatment itself* that the state of the patients improved, *but afterwards*:—"It was only then that the improvement was felt, and little by little the recovery was effected, without the patient's using medicine, or being subjected to a special treatment." Dr Sahndal further remarks, that in the works he has hitherto published on the subject, which include a large number of observations on this point, he has been led to the conclusion that the beneficial effects of compressed air are experienced by the patients even after the bath. These effects he attributes to oxidation of the blood, dependent on augmentation of pulmonary capacity, and consequent change in the chemism of respiration.

In the experiments instituted by Dr J. Lange with reference to the increase of strength under the influence of compressed air, it was found that this "increase continued to manifest itself not only at the time of the pressure, but later, also under an ordinary atmospheric pressure."

It is impossible within the limits of a brief essay to enumerate fully the experience of medico-pneumatic physicians in other forms of disease. Dr Bertin gives copious details of success in cases of affections of females, chiefly those connected with deficient functional action, complicated with hæmoptisis. The details of these cases, however, are avoided, as not suitable for the pages of a popular guide.

APPENDIX.

A.

THE BAROMETER AND NERVES.

A LADY, eighty years old, whom M. Foissac had attended for five-and-twenty years, suffered all her life from nervous affections, exhibiting all those combinations of symptoms, some real, some imaginary, which are ordinarily termed *vapeurs*. The constant complaint was want of strength, and relief only was found in animated society and lively conversation. For about ten years before M. Foissac published the details of this case, she had been subject to faintings, which at certain periods occurred several times in one day, and disappeared, perhaps, the next day, without any apparent cause. The syncope was never complete, but the face became pale, the pulse intermittent and threadlike, and the invalid was the subject of distressing alarms. At first M. Foissac thought probably the symptoms might arise from some derangement of the heart, but he was unable to establish any physical indications of mischief in that organ. M. Louis, who was called into consultation, was unable to discover any organic affection. M. Foissac at last acquired a knowledge of the real cause of the fainting. They occurred, he informs us, at the moment when the barometer was low, and the weather about to change. If the barometer, after descending a few millimetres, at length remained stationary, the faintings continued without being always very decided: they disappeared when the column of mercury rose and remained above the ordinary standard.

M. Foissac further tells us that he has sometimes predicted an immediate change of weather, when he has seen the faintings occur in this invalid, and he has even been able to announce what she felt without having been informed of it, *merely by an inspec-*

tion of the barometer. These observations are not singular. The author, in the course of his medical experience, has frequently met with analogous cases. In one case—a rheumatic and neuralgic patient—a change in the weather is frequently predicted for hours, sometimes a day, and even longer, with unerring certainty. The body in such persons is an unfailing barometer.

Dr Milliet in his "De l'Air Comprimé comme agent Thérapeutique,"* states, "The compressed air bath, in some sort, may be regarded as the victory over our atmosphere. We possess thus the means of augmenting or diminishing at will its natural pressure, which determines the equilibrium of the fluids circulating in our bodies. It is known, in fact, that in diminishing the ambient pressure there is a disturbance of the equilibrium and sanguineous extravasation. The phenomena which are observed in aeronautic ascensions are contrary to those which exhibit themselves under the influence of compressed air, by which is obtained a perfect equalisation of the functions of vegetative life. Two modes of transition may be viewed in relation to their action and effect—the one rapid or irregular transitions, either from a lower to a higher pressure or from a higher to a lower; the other a regulated and continuous one for a determined period."

B.

ROME AND ITS ODOURS.

"We send consumptive invalids of the most refined ideas and habits to Rome, in order that they shall enjoy its soft and equable winter temperature. But we forget that we condemn them at the same time to the revolting spectacle of, and poisonous exhalations from human excreta in their daily walks through the best and most frequented parts of the town. I remember well, after visiting one of the spots which, if correctly named, should rank among the most hallowed in the Eternal City, by its

* Lyon, 1854.

associations—the house of Rienzi, "the last of Romans"—being forced to return home at once from violent sickness, brought on by intolerable odours. Can health be found in an atmosphere so mephitic?"—*Disease of the Lungs*, by Dr Walshe, 3d ed. p. 585.

C.

THE NILE AND ITS WINDS.

"STILL? why, the winds pace up and down the valley of the Nile like his mad hounds howling for Actæon, like all the ghosts of all the three hundred dynasties anterior to history demanding to live again. . . . . Warm? why, the howadzi sat more voluminously swathed in cloaks and shawls, than mummies in their spiced bandages. They began bravely with sitting in front of the cabin, warmly wrapped in winter clothes, and only a little chilly, played that it was summer, and conversed in a feeble, poetic way of Egyptian climate. Gradually they retreated to the divans in the cabin, and cursed the cold." —*Nile Notes of a Howadzi*, by Curtis.

D.

LETTERS ON THE COMPRESSED AIR BATH.

I APPEND extracts from a few letters, addressed either to myself or friends, on some points of practical interest.

A gentleman writes as follows:—"Now, another word about my health. My complaint was an affection of the mucous membrane, which, in cold and humid countries like ours, is a very common disorder, though I must also say that it is by no means uncommon in the very southernmost and finest climates of France. I mention my complaint only because it may be a useful, at any rate, an interesting piece of information, that it was cured in an incredibly short time at Montpellier by the use of the Bain d'Air Comprimé, an institution under the care of a Dr Bertin, who has been using it for ten years and upwards with extraordinary success, for the cure of all that range of diseases

affecting the air vessels of the human frame—larynx complaints. Asthma in almost its most aggravated form yields marvellously to the influence of the air bath, and also attacks of the lungs, if not too far gone. Perhaps I have said so much as to raise your curiosity, if you chance never to have heard of the remedy. If so, I shall add two or three lines more, and put you in the way of gratifying your curiosity, if there be such. Never until this year has Dr Bertin published anything on the subject, but about two months ago he published a book, giving a full and very clear detail of this discovery by a scientific gentleman of Montpellier (Mons. Tabarié), for Dr Bertin is only superintendent medical gentleman, and the inventor, Mons. Tabarié, is now in Paris, exhibiting at the Exposition Universale his apparatus to the professional and scientific world, and I have reason to know that it is attracting great notice in Paris, and the probability is, that this wonderful curative agent, which has hardly been known beyond Montpellier until now, will not only be found ere long in Paris, but I confidently expect in Great Britain. It is certainly on the score of *humanity* that I feel it my duty to make this known in any case which comes in my way, and therefore you must not wonder at my giving you so long a story apparently about myself.

"When one speaks of a *bath*, one always conceives the idea of plunging, &c. &c. The Bain d'Air Comprimé is just an apartment of iron, in which you see so many chairs; and one, two, or more ladies or gentlemen, in their ordinary attire, or both together, may sit reading or working for two hours at a time. The *air of heaven, without any change in it*, is *forced* into the apartment (a close iron house, with plate-glass windows, strong to resist the pressure), and the air is *increased* in *pressure* upon the patients, *considerably over* thirty centimetres above the atmospheric pressure, so that it courses through the throat, ears, lungs, &c. &c.; in short, wherever there is a respiratory organ open, and this produces the curative effect. *How* it is produced, perhaps no one can well explain, but the fact is established, and the medical institute of France have admitted and rewarded it as an

invention. Patients are usually quite unconscious of any sensations whatever, at least generally, and it is safe even for an infant."

A gentleman, in writing to a friend who solicits information on the subject of the compressed air bath, states:—"I will answer yours of the 24th as concisely as I can. One of my lungs was affected, and I also laboured under a considerable amount of bronchial disease, and the doctors all told me that if I remained in England for the winter (1855), my life would not be worth a month's purchase. I then became very thin, could crawl about a mile an hour, was very weak, had an incessant hacking cough, and some nights did not dare to lie down in bed, and generally four nights out of seven had a mustard poultice on my throat for a quarter of an hour ere I went to sleep. This had been gradually increasing for three years, and I never moved out in a cold wind without a respirator. I chose Nice for climate, and left England in November 1855, *only for climate.* After I had been a couple of months at Nice, with not the slightest improvement, and never daring to face the wind without my respirator, I began to think the change had done me no good; I must also mention I never slept a night through without waking choked, once or twice. By chance I heard of the system of compressed air practised by a physician, Dr Milliet, within ten minutes' walk of my house. I went to see Dr Milliet, not with much idea, however, of his doing me any good. This was on a Saturday. That night, and on the following Sunday night, I slept, sitting up in bed; I never was worse. On the Monday I took my first seance of compressed air; that night I slept quiet all the night. The next day the second seance; appetite returned, and from that day to this I have never ailed to signify, always sleeping without inconvenience. I have never applied a mustard poultice to my throat, and have never put on or required my respirator. I took forty-five seances, I think, ere I was pronounced cured. In two months from the commencement I was strong, stout, in good wind, and often stopped myself, quite alarmed at the pace I was walking; in short, I was fit for another trip to Kedar Kanta. I saw a young lady cured to a

certain degree, who had had asthma for twenty years, she was then twenty-five years old.

"*P.S.*—I may just mention the second winter of 1856–57 I was at Nice, my two youngest children, three years and eighteen months old, had the hooping-cough; I sent them into the compressed air chamber. From the first seance all hoop and spasmodic cough ceased, and in a week they were cured, whilst other children, treated in the ordinary way, were dying, and lingering for months."

The following extract is from the letter of a Baronet, dated January 1854, who had been under the compressed air-bath treatment at Lyons:—"I am conscious of a palpable improvement in my health; my asthma and bronchitis, to which for years I have been subject, are very sensibly diminished. It is true, during the cure the disease seemed exasperated, so much so, that if I had not had strong faith in the efficacy of the treatment I should have given it up; but I was convinced (rightly as it turned out) that it was merely the disease resenting the intrusion of the remedy; this made it worth my while to go and live in the establishment, for which there are facilities; the result has been, that for months since May 1853, I have scarcely had any asthma at all, and though I dare not venture to hope that a disease of such long standing can be eradicated entirely, I can only say that up to this time I am conscious of a great benefit. I have heard of several other marked and extraordinary cases, especially that of one (medical) gentleman, who was brought up by three other physicians, apparently *in extremis* for want of breath, and is now a healthy man."

E.

THE REGISTRAR-GENERAL'S STATISTICS.

Dr Nicol, in a recent communication to the *Times*, explains that the observations applied to Malvern, as included in the sub-district of Hanley, are also applicable to Llandudno.